



Paragon Analytics

Radiochemistry Case Narrative

²²⁶Radium by EPA Method 903.1(m)

Kent & Sullivan, Inc.

Ross Adams

Paragon WO 0405097

1. This report consists of the analytical results and supporting documentation for thirty solid samples received by Paragon on 5/11/04.
2. Samples in batch RE040701-1 were digested according to QASS 278662 and therefore aliquoted and prepared as water samples and obtaining a chemical recovery. The samples were then prepared and analyzed according to Paragon Analytics procedures SOP783R5. Samples in batch RE040701-2 were run as soil samples according to SOP783R5. The analyses were completed on 7/18/04.
3. The analysis results for these samples are reported on a 'dry weight' basis in units of pCi/gram.
4. Paragon Analytics follows the convention outlined in ANSI N42.23 for reporting significant digits in the TPU and MDC results. ANSI N42.23 states that the TPU result should be rounded to two significant digits and that the MDC result should be rounded to the same decimal place as the TPU result. In practice, this could result in an MDC result with a reported value of 0 for samples with significant activity, including the batch laboratory control sample.
5. Due to uncertainty associated with the ICP-AES determination of barium concentration in the samples, the calculated yield for samples in batch RE040701-1 fell between 100% and 110%. To minimize the potential for low bias, results have been calculated conservatively assuming quantitative chemical yield (100%). The magnitude of the low bias is estimated to be less than 10% of the reported value and is acceptable according the Paragon LQAP. This sample is identified with a "Y1" flag on the final reports.
6. The requested MDC was not met for these samples. Also, the requested MDC was not met for method blanks RE040701-1MB and -2MB. However, sample activity is greater than five times the achieved MDCs for the respective blanks. Both method blanks were counted for a maximum count time of 90 minutes and results are reported without further qualification. These samples are identified with an "M" or "M3" flag on the final reports. The reported activity for samples with an "M3" flag exceeds the achieved MDC.
7. No further anomalous situations were encountered during the preparation or analysis of these samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.



Radiochemistry Instrument Technician

7-23-04

Date



Radiochemistry Final Data Review

FOR SCOTT HAFEMAN 7-23-04

Date

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 1

**SAMPLE RESULTS
SUMMARY**

Ra-226 by Radon Emanation - Method 903.1 Sample Results Summary

Client Name: Kent & Sullivan Inc.

Client Project Name: Ross Adams

Client Project Number:

Laboratory Name: Paragon Analytics
PAI Work Order: 0405097

Reported on: Friday, July 23, 2004
3:29:19 PM

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Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405097-1	HR-01	Sample	Ra-226	223 +/- 40	1	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-2	MR-01	Sample	Ra-226	234 +/- 42	1	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-3	MR-02	Sample	Ra-226	179 +/- 32	0	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-4	GR-01	Sample	Ra-226	0.66 +/- 0.33	0.47	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-5	GR-02	Sample	Ra-226	2.01 +/- 0.49	0.32	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-6	GR-03	Sample	Ra-226	1.02 +/- 0.21	0.12	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-7	GR-04	Sample	Ra-226	11.4 +/- 2.2	0.4	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-8	GR-05	Sample	Ra-226	0.81 +/- 0.35	0.45	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-9	GR-06	Sample	Ra-226	0.71 +/- 0.27	0.31	pCi/g	SOLID	RE040701-2	7/14/2004	M3

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.

M - The requested MDC was not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Date Printed: Friday, July 23, 2004

Paragon Analytics
LIMS Version: 5.041A

Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

Ra-226 by Radon Emanation - Method 903.1 Sample Results Summary

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Laboratory Name: Paragon Analytics
PAI Work Order: 0405097

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3:29:19 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405097-10	GR-07	Sample	Ra-226	0.64 +/- 0.26	0.31	pCi/g	SOLID	RE040701-2	7/15/2004	M3
0405097-11	GR-08	Sample	Ra-226	0.49 +/- 0.27	0.37	pCi/g	SOLID	RE040701-2	7/14/2004	M3
0405097-12	GR-09	Sample	Ra-226	0.85 +/- 0.31	0.35	pCi/g	SOLID	RE040701-2	7/15/2004	M3
0405097-13	GR-10	Sample	Ra-226	0.93 +/- 0.28	0.26	pCi/g	SOLID	RE040701-2	7/15/2004	M3
0405097-14	QM-01	Sample	Ra-226	1.07 +/- 0.22	0.11	pCi/g	SOLID	RE040701-2	7/15/2004	M3
0405097-15	QM-02	Sample	Ra-226	0.46 +/- 0.11	0.08	pCi/g	SOLID	RE040701-2	7/15/2004	M3
0405097-16	QM-03	Sample	Ra-226	0.36 +/- 0.10	0.10	pCi/g	SOLID	RE040701-2	7/15/2004	M3
0405097-17	300-01	Sample	Ra-226	1550 +/- 280	0	pCi/g	SOLID	RE040701-1	7/12/2004	M3
0405097-18	300-02	Sample	Ra-226	53.5 +/- 9.6	0.1	pCi/g	SOLID	RE040701-2	7/15/2004	M3

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

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Paragon Analytics
LIMS Version: 5.041A

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Ra-226 by Radon Emanation - Method 903.1 Sample Results Summary

Client Name: Kent & Sullivan Inc.

Client Project Name: Ross Adams

Client Project Number:

Laboratory Name: Paragon Analytics
PAI Work Order: 0405097

Reported on: Friday, July 23, 2004
3:29:20 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405097-19	700-01	Sample	Ra-226	1960 +/- 350	0	pCi/g	SOLID	RE040701-1	7/12/2004	Y1,M3
0405097-20	700-02	Sample	Ra-226	368 +/- 66	0	pCi/g	SOLID	RE040701-2	7/16/2004	M3
0405097-21	700-03	Sample	Ra-226	2210 +/- 390	0	pCi/g	SOLID	RE040701-1	7/13/2004	Y1,M3
0405097-22	700-04	Sample	Ra-226	447 +/- 80	1	pCi/g	SOLID	RE040701-1	7/13/2004	Y1,M3
0405097-23	900-01	Sample	Ra-226	481 +/- 86	0	pCi/g	SOLID	RE040701-1	7/13/2004	M3
0405097-24	900-02	Sample	Ra-226	1470 +/- 260	0	pCi/g	SOLID	RE040701-1	7/13/2004	Y1,M3
0405097-25	900-03	Sample	Ra-226	274 +/- 49	0	pCi/g	SOLID	RE040701-1	7/13/2004	M3
0405097-26	900-04	Sample	Ra-226	131 +/- 24	0	pCi/g	SOLID	RE040701-2	7/16/2004	M3
0405097-27	900-05	Sample	Ra-226	160 +/- 29	0	pCi/g	SOLID	RE040701-2	7/18/2004	M3

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

BDL - Below Detection Limit

Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

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Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405097-28	OSA-01	Sample	Ra-226	1650 +/- 300	0	pCi/g	SOLID	RE040701-1	7/13/2004	Y1,M3
0405097-29	OSA-02	Sample	Ra-226	498 +/- 89	1	pCi/g	SOLID	RE040701-1	7/13/2004	Y1,M3
0405097-30	OSA-03	Sample	Ra-226	482 +/- 86	1	pCi/g	SOLID	RE040701-1	7/13/2004	M3

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

Date Printed: Friday, July 23, 2004

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 2

**QC RESULTS
SUMMARY**

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Method Blank Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Lab ID: RE040701-1MB	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1	Final Aliquot: 0.995 g Result Units: pCi/g
	Date Collected: 01-Jul-04	Run ID: RE040712-1A	File Name: Manual Entry
	Date Prepared: 01-Jul-04	Count Time: 15 minutes	
	Date Analyzed: 13-Jul-04		

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	-0.09 +/- 0.38	0.69	Y1,U,M

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13530	13780	ug	102	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Method Blank Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Lab ID: RE040701-2MB	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 90 minutes	Final Aliquot: 3.00 g Result Units: pCi/g File Name: Manual Entry
	Date Collected: 08-Jul-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04		

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	-0.011 +/- 0.038	0.068	U,M

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: REM0405097-1

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5 Laboratory Control Sample(s)

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Lab ID: RE040701-1LCS	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 01-Jul-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes	Final Aliquot: 0.995 g Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	42.6 +/- 7.8	0.6	48.2	88.4	70 - 130	P,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13530	13450	ug	99.4	40 - 110 %	

Comments:

Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS Recovery within control limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: REM0405097-1

Date Printed: Friday, July 23, 2004

Paragon Analytics
LIMS Version: 5.041A

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Laboratory Control Sample(s)

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Lab ID: RE040701-2LCS	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 08-Jul-04 Date Prepared: 08-Jul-04 Date Analyzed: 18-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes	Final Aliquot: 3.00 g Result Units: pCi/g File Name: Manual Entry
-----------------------	--	--	---

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	16.8 +/- 3.2	0.4	16.0	105	70 - 130	P,M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.
LT - Result is less than Requested MDC, greater than sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS Recovery within control limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: REM0405097-1

Date Printed: Friday, July 23, 2004

Paragon Analytics

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Matrix Spike Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: QM-03 Lab ID: 0405097-16MS	Sample Matrix: SOLID Prep SOP: PAI 783 Date Collected: 03-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.62 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
---	--	--	--

CASNO	Target Nuclide	Matrix Spike	Sample Results	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	9.7	0.36	0.2	13.3	70.6	70 - 130	P,M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

N - Matrix Spike Recovery outside control limits

P - Matrix Spike Recovery within control limits

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: REM0405097-1

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Duplicate Sample Results (DER)

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: HR-01
Lab ID: 0405097-1DUP

Sample Matrix: SOLID
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 08-Jul-04
Date Analyzed: 14-Jul-04

Prep Batch: RE040701-2
QCBatchID: RE040701-2-1
Run ID: RE040714-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 3.20 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Analyte	Sample Result +/- 2s TPU	Duplicate Result +/- 2s TPU	DER	Control Limit	Lab Qualifiers
13982-63-3	Ra-226	223 +/- 40	233 +/- 42	0.18	2.13	M3

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

LT - Result is less than Request MDC, greater than sample specific MDC

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

DER - Duplicate Error Ratio

BDL - Below Detection Limit

NR - Not Reported

Data Package ID: REM0405097-1

Date Printed: Friday, July 23, 2004

Paragon Analytics
LIMS Version: 5.041A

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Duplicate Sample Results (DER)

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID:	GR-07
Lab ID:	0405097-10DUP

Sample Matrix: SOLID
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 08-Jul-04
Date Analyzed: 15-Jul-04

Prep Batch: RE040701-2
QCBatchID: RE040701-2-1
Run ID: RE040714-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 3.14 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Analyte	Sample Result +/- 2 s TPU	Duplicate Result +/- 2 s TPU	DER	Control Limit	Lab Qualifiers
13982-63-3	Ra-226	0.64 +/- 0.26	1.07 +/- 0.33	1.01	2.13	M3

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

LT - Result is less than Request MDC, greater than sample specific MDC

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

DER - Duplicate Error Ratio

BDL - Below Detection Limit

NR - Not Reported

Data Package ID: REM0405097-1

Date Printed: Friday, July 23, 2004

Paragon Analytics
LIMS Version: 5.041A

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Duplicate Sample Results (DER)

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-01
Lab ID: 0405097-19DUP

Sample Matrix: SOLID
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 01-Jul-04
Date Analyzed: 13-Jul-04

Prep Batch: RE040701-1
QCBatchID: RE040701-1-1
Run ID: RE040712-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 0.288 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Analyte	Sample Result +/- 2 s TPU	Duplicate Result +/- 2 s TPU	DER	Control Limit	Lab Qualifiers
13982-63-3	Ra-226	1960 +/- 350	2070 +/- 370	0.22	2.13	Y1,M3

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

LT - Result is less than Request MDC, greater than sample specific MDC

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

Abbreviations:

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DER - Duplicate Error Ratio

BDL - Below Detection Limit

NR - Not Reported

Data Package ID: REM0405097-1

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PARAGON ANALYTICS
Radiochemistry Data Package

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Section 3

**INDIVIDUAL
SAMPLE RESULTS**

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: HR-01 Lab ID: 0405097-1	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 06-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.22 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	223 +/- 40	1	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Duplicate Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: HR-01
Lab ID: 0405097-1DUP

Sample Matrix: SOLID
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 08-Jul-04
Date Analyzed: 14-Jul-04

Prep Batch: RE040701-2
QCBatchID: RE040701-2-1
Run ID: RE040714-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 3.20 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	233 +/- 42	1	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Date Printed: Friday, July 23, 2004

Paragon Analytics
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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: MR-01 Lab ID: 0405097-2	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.06 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	234 +/- 42	1	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: MR-02 Lab ID: 0405097-3	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.81 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	179 +/- 32	0	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-01 Lab ID: 0405097-4	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.86 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.66 +/- 0.33	0.47	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-02 Lab ID: 0405097-5	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.69 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	2.01 +/- 0.49	0.32	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-03 Lab ID: 0405097-6	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 16-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 90 minutes Report Basis: Dry Weight	Final Aliquot: 3.66 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1.02 +/- 0.21	0.12	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-04 Lab ID: 0405097-7	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.15 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	11.4 +/- 2.2	0.4	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-05 Lab ID: 0405097-8	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.12 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.81 +/- 0.35	0.45	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

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Ra-226 by Radon Emanation - Method 903.1

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Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-06 Lab ID: 0405097-9	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.71 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.71 +/- 0.27	0.31	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-07 Lab ID: 0405097-10	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.14 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.64 +/- 0.26	0.31	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Duplicate Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-07 Lab ID: 0405097-10DUP	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.14 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	--

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1.07 +/- 0.33	0.33	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-08 Lab ID: 0405097-11	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 14-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.11 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.49 +/- 0.27	0.37	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID:	GR-09
Lab ID:	0405097-12

Sample Matrix: SOLID
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 08-Jul-04
Date Analyzed: 15-Jul-04

Prep Batch: RE040701-2
QCBatchID: RE040701-2-1
Run ID: RE040714-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 3.01 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.85 +/- 0.31	0.35	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: GR-10 Lab ID: 0405097-13	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.07 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.93 +/- 0.28	0.26	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: QM-01 Lab ID: 0405097-14	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 03-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 90 minutes Report Basis: Dry Weight	Final Aliquot: 3.46 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1.07 +/- 0.22	0.11	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: QM-02 Lab ID: 0405097-15	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 03-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 90 minutes Report Basis: Dry Weight	Final Aliquot: 3.07 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.46 +/- 0.11	0.08	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: QM-03 Lab ID: 0405097-16	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 03-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 15-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 90 minutes Report Basis: Dry Weight	Final Aliquot: 3.02 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
---------------------------------------	--	--	--

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.36 +/- 0.10	0.10	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 300-01 Lab ID: 0405097-17	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 04-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 12-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.546 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1550 +/- 280	0	M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13590	13250	ug	97.5	40 - 110 %	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 300-02
Lab ID: 0405097-18

Sample Matrix: SOLID
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 08-Jul-04
Date Analyzed: 15-Jul-04

Prep Batch: RE040701-2
QCBatchID: RE040701-2-1
Run ID: RE040714-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 3.81 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	53.5 +/- 9.6	0.1	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-01 Lab ID: 0405097-19	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 12-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.288 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1960 +/- 350	0	Y1,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13570	14020	ug	103	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Duplicate Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-01 Lab ID: 0405097-19DUP	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.288 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
---	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	2070 +/- 370	0	Y1,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13570	14400	ug	106	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

W - DER is greater than Warming Limit of 1.42

D - DER is greater than Control Limit of 2.13

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-02 Lab ID: 0405097-20	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 08-Jul-04 Date Analyzed: 16-Jul-04	Prep Batch: RE040701-2 QCBatchID: RE040701-2-1 Run ID: RE040714-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 3.08 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	--

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	368 +/- 66	0	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Date Printed: Friday, July 23, 2004

Paragon Analytics
LIMS Version: 5.041A

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-03 Lab ID: 0405097-21	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.258 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	2210 +/- 390	0	Y1,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13570	14040	ug	103	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-04 Lab ID: 0405097-22	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.458 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	447 +/- 80	1	Y1,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13580	14300	ug	105	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 900-01 Lab ID: 0405097-23	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.460 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	481 +/- 86	0	M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13550	12300	ug	90.8	40 - 110 %	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 900-02 Lab ID: 0405097-24	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.288 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1470 +/- 260	0	Y1,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13550	14410	ug	106	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 900-03 Lab ID: 0405097-25	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 07-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 1.01 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	--

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	274 +/- 49	0	M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13610	11830	ug	86.9	40 - 110 %	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 900-04
Lab ID: 0405097-26

Sample Matrix: SOLID
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 08-Jul-04
Date Analyzed: 16-Jul-04

Prep Batch: RE040701-2
QCBatchID: RE040701-2-1
Run ID: RE040714-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 3.15 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	131 +/- 24	0	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 900-05	Sample Matrix: SOLID	Prep Batch: RE040701-2	Final Aliquot: 3.38 g
Lab ID: 0405097-27	Prep SOP: PAI 783 Rev 5	QCBatchID: RE040701-2-1	Prep Basis: Dry Weight
	Date Collected: 07-May-04	Run ID: RE040714-1A	Moisture(%): NA
	Date Prepared: 08-Jul-04	Count Time: 15 minutes	Result Units: pCi/g
	Date Analyzed: 18-Jul-04	Report Basis: Dry Weight	File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	160 +/- 29	0	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: OSA-01 Lab ID: 0405097-28	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 06-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.228 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1650 +/- 300	0	Y1,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13560	14580	ug	108	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: OSA-02	Sample Matrix: SOLID	Prep Batch: RE040701-1	Final Aliquot: 0.472 g
Lab ID: 0405097-29	Prep SOP: PAI 783 Rev 5	QCBatchID: RE040701-1-1	Prep Basis: Dry Weight
	Date Collected: 06-May-04	Run ID: RE040712-1A	Moisture(%): NA
	Date Prepared: 01-Jul-04	Count Time: 15 minutes	Result Units: pCi/g
	Date Analyzed: 13-Jul-04	Report Basis: Dry Weight	File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	498 +/- 89	1	Y1,M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13610	14000	ug	103	40 - 110 %	Y1

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: OSA-03 Lab ID: 0405097-30	Sample Matrix: SOLID Prep SOP: PAI 783 Rev 5 Date Collected: 06-May-04 Date Prepared: 01-Jul-04 Date Analyzed: 13-Jul-04	Prep Batch: RE040701-1 QCBatchID: RE040701-1-1 Run ID: RE040712-1A Count Time: 15 minutes Report Basis: Dry Weight	Final Aliquot: 0.472 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: Manual Entry
--	--	--	---

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	482 +/- 86	1	M3

Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
BARIUM	13600	12720	ug	93.5	40 - 110 %	

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: REM0405097-1

000050

PARAGON ANALYTICS
Radiochemistry Data Package

Section 4

4

RAW DATA

000051

Ra-226 by Radon Emanation - Method 903.1 Raw Data Report

Laboratory Name: Paragon Analytics

PAI Work Order: 0405097

Prep SOP: PAI 783

Analytical SOP: PAI 783

Reported on: Friday, July 23, 2004

3:22:31 PM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date/Time	Decay Date/Time	Matrix %Moist.	Samp Aliq Analy Aliq	Inst ID Det ID	AnRunID File Name	Count Gr Cnts	BaseEff Bkg Cnts	CnxDur(min)	Activity +/- Yield	MDC	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
0405097-1 SMP	Ra-226 Trg. Analyte	5/6/2004 7:00:00 PM	RE040701-2-1	7/11/2004 6:54:00 PM	7/14/2004 8:52:00 AM	NA	3.22 g	A13	Alpha Scin Manual Entry	7/14/2004 19361.000	224.78%	15	223	1	pCi/g	NA	M3
0405097-1 DUP	Ra-226 Trg. Analyte	5/6/2004 7:00:00 PM	RE040701-2-1	7/11/2004 7:11:00 PM	7/14/2004 8:52:00 AM	NA	3.2 g	B14	Alpha Scin Manual Entry	7/14/2004 21414.998	239.70%	15	233	1	pCi/g	0.18	
0405097-2 SMP	Ra-226 Trg. Analyte	5/7/2004 1:30:00 PM	RE040701-2-1	7/11/2004 6:54:00 PM	7/14/2004 9:14:00 AM	NA	3.06 g	A1	Alpha Scin Manual Entry	7/14/2004 19328.000	223.94%	15	234	1	pCi/g	NA	M3
0405097-3 SMP	Ra-226 Trg. Analyte	5/7/2004 1:20:00 PM	RE040701-2-1	7/11/2004 6:54:00 PM	7/14/2004 9:14:00 AM	NA	3.81 g	B2	Alpha Scin Manual Entry	7/14/2004 21859.000	265.56%	15	179	0	pCi/g	NA	M3
0405097-4 SMP	Ra-226 Trg. Analyte	5/7/2004 1:11:00 PM	RE040701-2-1	7/11/2004 6:54:00 PM	7/14/2004 9:33:00 AM	NA	3.86 g	A3	Alpha Scin Manual Entry	7/14/2004 223.000	263.58%	15	66	0.47	pCi/g	NA	M3
0405097-5 SMP	Ra-226 Trg. Analyte	5/7/2004 1:38:00 PM	RE040701-2-1	7/11/2004 6:54:00 PM	7/14/2004 9:33:00 AM	NA	3.86 g	B4	Alpha Scin Manual Entry	7/14/2004 142.000	246.92%	15	201	0.32	pCi/g	NA	M3
0405097-6 SMP	Ra-226 Trg. Analyte	5/7/2004 2:00:00 PM	RE040701-2-1	7/11/2004 9:57:00 AM	7/16/2004 1:32:00 AM	NA	3.66 g	A9	Alpha Scin Manual Entry	7/16/2004 721.000	251.49%	90	102	0.12	pCi/g	NA	M3
0405097-7 SMP	Ra-226 Trg. Analyte	5/7/2004 2:20:00 PM	RE040701-2-1	7/11/2004 7:11:00 PM	7/16/2004 5:57:00 AM	NA	3.15 g	B8	Alpha Scin Manual Entry	7/14/2004 906.000	201.38%	15	114	0.4	pCi/g	NA	M3
0405097-8 SMP	Ra-226 Trg. Analyte	5/7/2004 2:38:00 PM	RE040701-2-1	7/11/2004 7:11:00 PM	7/14/2004 10:19:00 AM	NA	3.12 g	A9	Alpha Scin Manual Entry	7/14/2004 152.000	251.49%	15	81	0.45	pCi/g	NA	M3
0405097-9 SMP	Ra-226 Trg. Analyte	5/7/2004 2:56:00 PM	RE040701-2-1	7/11/2004 7:11:00 PM	7/15/2004 10:19:00 AM	NA	3.11 g	B10	Alpha Scin Manual Entry	7/14/2004 100.000	209.96%	15	77	0.31	pCi/g	NA	M3
0405097-10 SMP	Ra-226 Trg. Analyte	5/7/2004 3:10:00 PM	RE040701-2-1	7:11:00 PM	7/15/2004 10:50:00 AM	NA	3.14 g	A13	Alpha Scin Manual Entry	7/15/2004 118.000	224.78%	15	64	0.31	pCi/g	NA	M3

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 10-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

+ - Duplicate RPD not within limits.

LT - Result is less than Request MDC, greater than sample specific MDC

* - Tracer Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Tracer Basis is 'Dry Weight' while the Report Basis is 'As Received'.

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery above upper control limit.

H - LCS Recovery below lower control limit.

P - LCS, Matrix Spike Recovery within control limits

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

- 1) The Tracer results are not yield corrected (i.e. activity measured not activity added).
- 2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR- Tracer

TA - Target Analyte

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

DER - Duplicate Error Ratio

BDL - Below Detection Limit

Ra-226 by Radon Emanation - Method 903.1 Raw Data Report

Laboratory Name: Paragon Analytics
 PAI Work Order: 0405097

Prep SOP: PAI 783
 Analytical SOP: PAI 783

Reported on: Friday, July 23, 2004
 3:22:31 PM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date/Time	Decay Date/Time	%Moist.	Matrix	Samp Alq Analy Alq	Inst ID Det ID	AnRunID File Name	Count	Gr Cnts Bkg Cnts	BaseEff	CntDur(min)	Activity +/- Yield	MDC	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags	
0405097-10	Ra-226	5/7/2004 3:10:00 PM	RE040701-2-1	7/11/2004 6:54:00 PM	7/15/2004 10:50:00 AM	NA	SOLID	3.14 g	B14	Alpha Scn Manual Entry	7/15/2004 2:50 PM	187,000 61,000	239.70%	15	1.07	0.33	pCi/g	1.01		
DUP	Trg. Analyte															NA	Dry Weight	NA	M3	
0405097-11	Ra-226	5/7/2004 3:10:00 PM	RE040701-2-1	7/11/2004 10:43:00 AM	7/14/2004 11:23:00 AM	NA	SOLID	3.11 g	A12	Alpha Scn Manual Entry	7/14/2004 3:44 PM	84,000 41,000	229.61%	15	0.49	0.37	pCi/g			
SMR	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-12	Ra-226	5/7/2004 3:20:00 PM	RE040701-2-1	7/11/2004 7:11:00 PM	7/15/2004 11:23:00 AM	NA	SOLID	3.01 g	A1	Alpha Scn Manual Entry	7/15/2004 3:23 PM	54,000 43,000	144,000 162,000	223.94% 265.56%	15	0.85 0.93	0.35 0.26	pCi/g		
SMR	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-13	Ra-226	5/7/2004 3:35:00 PM	RE040701-2-1	7/11/2004 7:32:00 PM	7/15/2004 8:51:00 AM	NA	SOLID	3.07 g	B2	Alpha Scn Manual Entry	7/15/2004 3:23 PM	NA	NA	NA	0.28	NA	Dry Weight	NA	M3	
SMR	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-14	Ra-226	5/3/2004 1:40:00 PM	RE040701-2-1	7/11/2004 7:32:00 PM	7/15/2004 8:51:00 AM	NA	SOLID	3.46 g	A10	Alpha Scn Manual Entry	7/15/2004 12:59 PM	939,000 222,000	921.98% 224.17%	90	1.07 0.46	0.11 0.08	pCi/g			
SMR	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-15	Ra-226	5/3/2004 2:00:00 PM	RE040701-2-1	7/11/2004 7:32:00 PM	7/15/2004 1:57:00 AM	NA	SOLID	3.07 g	B12	Alpha Scn Manual Entry	7/15/2004 12:59 PM	95,000 30,000	1494,000 263,58%	90	0.46 0.11	0.11 NA	pCi/g			
SMR	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-16	Ra-226	5/3/2004 2:20:00 PM	RE040701-2-1	7/11/2004 7:32:00 PM	7/15/2004 10:21:00 AM	NA	SOLID	3.02 g	A8	Alpha Scn Manual Entry	7/15/2004 4:15 PM	362,000 150,000	212.25%	90	0.36	0.10	pCi/g			
SMR	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-17	Ra-226	5/4/2004 9:50:00 AM	RE040701-1-1	7/04/2004 2:53:00 PM	7/12/2004 1:26:00 AM	NA	SOLID	0.548 g	A10	Alpha Scn Manual Entry	7/12/2004 3:32 PM	20,000 NA	97.5%	15	0.2	0.2	pCi/g			
MS	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-18	Ra-226	5/7/2004 4:30:00 PM	RE040701-2-1	7/11/2004 7:32:00 PM	7/15/2004 1:57:00 AM	NA	SOLID	3.81 g	B4	Alpha Scn Manual Entry	7/15/2004 3:57 PM	7935,000 14,000	246.92%	15	53.5	0.1	pCi/g			
SMR	Trg. Analyte														NA	Dry Weight	NA	M3		
0405097-19	Ra-226	5/7/2004 5:00:00 PM	RE040701-1-1	7/04/2004 2:53:00 PM	7/12/2004 10:26:00 AM	NA	SOLID	0.289 g	B12	Alpha Scn Manual Entry	7/12/2004 3:32 PM	30642,002 11,000	224.17% 103.0%	15	1960 350	0 NA	pCi/g			
SMR	Trg. Analyte														NA	Dry Weight	NA	Y1,M3		

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

+ - Duplicate RPD not within limits.

L/T - Result is less than Request MDC, greater than sample specific MDC

* - Analyte Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Analyte Basis is 'Dry Weight' while the Report Basis is 'As Received'.

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

- 1) The Tracer results are not yet corrected (i.e. activity measured not activity added).
- 2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR- Tracer

TA - Target Analyte

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

DER - Duplicate Error Ratio

BDL - Below Detection Limit

Ra-226 by Radon Emanation - Method 903.1 Raw Data Report

Laboratory Name: Paragon Analytics
 PAI Work Order: 0405097

Prep SOP: PAI 783
 Analytical SOP: PAI 783

Reported on: Friday, July 23, 2004
 3:28:15 PM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date / Time	Decay Date/Time	Matrix %Moist.	Samp Alq Analy Alq	Inst ID Det ID	AnRundID File Name	Count Date/Time	Gr Crits Bkg Crits	BaseEff ProgEff	CnDur(min) Yield	MDC	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
0405097-19	Ra-226	5/7/2004 5:00:00 PM	RE040701-1-1	7/04/2004 2:53:00 PM	7/13/2004 8:29:00 AM	NA	0.288 ♀	A13	Alpha Scan	RE040712-1A 7/13/2004	15,000 NA	34408.000 224.78%	15 106.0%	2070 370	0 NA	pCi/g	0.22
DUP	Trg. Analyte									Manual Entry	1:22:29 PM				Dry Weight	NA	Y1,M3
0405097-20	Ra-226	5/7/2004 5:30:00 PM	RE040701-2-1	7/04/2004 7:32:00 PM	7/11/2004 8:38:00 AM	NA	0.308 ♀	A4	Alpha Scan	RE040714-1A 7/16/2004	42,000 NA	51237.000 250.25%	15 NA	368 66	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	1:02 PM				Dry Weight	NA	M3
0405097-21	Ra-226	5/7/2004 5:20:00 PM	RE040701-1-1	7/04/2004 2:53:00 PM	7/13/2004 8:29:00 AM	NA	0.288 ♀	B14	Alpha Scan	RE040712-1A 7/13/2004	36063.004 6,000	239.70%	15 103.0%	2210 390	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	12:29 PM				Dry Weight	NA	Y1,M3
0405097-22	Ra-226	5/7/2004 6:00:00 PM	RE040701-1-1	7/04/2004 2:53:00 PM	7/13/2004 8:47:00 AM	NA	0.458 ♀	A1	Alpha Scan	RE040712-1A 7/13/2004	278,000 1:09 PM	223.94%	15 105.0%	447 80	1 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	1:09 PM				Dry Weight	NA	Y1,M3
0405097-23	Ra-226	5/7/2004 1:00:00 PM	RE040701-1-1	7/04/2004 2:53:00 PM	7/13/2004 8:47:00 AM	NA	0.46 ♀	B2	Alpha Scan	RE040712-1A 7/13/2004	137,21,000 6,000	266.56%	15 90.8%	481 86	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	1:09 PM				Dry Weight	NA	M3
0405097-24	Ra-226	5/7/2004 12:10:00 PM	RE040701-1-1	7/04/2004 2:53:00 PM	7/13/2004 9:15:00 AM	NA	0.288 ♀	A3	Alpha Scan	RE040712-1A 7/13/2004	286,86,000 31,000	263.58%	15 106.0%	1470 260	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	1:46 PM				Dry Weight	NA	Y1,M3
0405097-25	Ra-226	5/7/2004 12:30:00 PM	RE040701-1-1	7/04/2004 3:25:00 PM	7/13/2004 9:15:00 AM	NA	1.01 ♀	B4	Alpha Scan	RE040712-1A 7/13/2004	151,84,000 15,000	246.92%	15 86.9%	274 49	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	1:46 PM				Dry Weight	NA	M3
0405097-26	Ra-226	5/7/2004 7:00:00 PM	RE040701-2-1	7/11/2004 3:25:00 PM	7/16/2004 8:38:00 AM	NA	3.15 ♀	B8	Alpha Scan	RE040714-1A 7/16/2004	150,25,000 11,000	201.38%	15 NA	1470 24	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	1:02 PM				Dry Weight	NA	M3
0405097-27	Ra-226	5/7/2004 6:40:00 PM	RE040701-2-1	7/16/2004 9:04:00 AM	7/18/2004 3:47:00 PM	NA	3.38 ♀	A6	Alpha Scan	RE040714-1A 7/18/2004	149,47,999 8:03 PM	252.48%	15 NA	160 29	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	3:47:00 PM				Dry Weight	NA	M3
0405097-28	Ra-226	5/6/2004 2:00:00 PM	RE040701-1-1	7/04/2004 3:25:00 PM	7/13/2004 9:40:00 AM	NA	0.229 ♀	A6	Alpha Scan	RE040712-1A 7/13/2004	24268.000 23,000	252.48%	15 108.0%	1650 300	0 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	2:37 PM				Dry Weight	NA	Y1,M3
0405097-29	Ra-226	5/6/2004 7:00:00 PM	RE040701-1-1	7/04/2004 3:25:00 PM	7/13/2004 9:40:00 AM	NA	0.474 ♀	B8	Alpha Scan	RE040712-1A 7/13/2004	12075.000 10,000	201.38%	15 103.0%	498 89	1 NA	pCi/g	NA
SMP	Trg. Analyte									Manual Entry	2:37 PM				Dry Weight	NA	Y1,M3

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

U - Result is less than the sample specific MDC.
 Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
 Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42
 D - DER is greater than Control Limit of 2.13
 + - Duplicate RPD not within limits.

L1 - Result is less than Request MDC, greater than sample specific MDC
 P - Matrix Spike Recovery within control limits
 N - Matrix Spike Recovery outside control limits
 NC - Not Calculated for duplicate results less than 5 times MDC
 B - Analyte concentration greater than MDC.
 B3 - Analyte concentration greater than MDC but less than Requested MDC.
 # - Aliquot Basis is 'As Received' while the Report Basis is 'As Received'.
 C - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

- Notes:
- 1) The Tracer results are not yield corrected (i.e. activity measured not activity added).
 - 2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR - Tracer TA - Target Analyte
 TPU - Total Propagated Uncertainty (see PAI SOP 743)
 MDC - Minimum Detectable Concentration (see PAI SOP 709)
 DER - Duplicate Error Ratio
 BDL - Below Detection Limit

Ra-226 by Radon Emanation - Method 903.1 Raw Data Report

Laboratory Name: Paragon Analytics
 PAI Work Order: 0405097

Prep SOP: PAI 783
 Analytical SOP: PAI 783

Reported on: Friday, July 23, 2004
 3:28:15 PM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date/Time	Decay Date/Time	Matrix %Moist.	Samp/Alq Analy/Alq	Inst ID Det ID	AnRunID File Name	Count Date/Time	Gr Cnts Bkg Cnts	BaseEff ProgEff	ChDur(min)	Activity +/- Yield	2 s TPU	Declv	DER RPD	ReportUnits ReportBasis	%Spk. Recov Flags
0405097-30	Ra-226	5/6/2004 5:00:00 PM	RE040701-1-1	7/04/2004 3:25:00 PM	7/13/2004 10:07:00 AM	SOLID	0.475 g	A9	Alpha Scan	RE040712-1A 7/13/2004	13694.000 19.000	251.49%	15	482	1	pCi/g	NA	NA	M3
RE040701-1	Ra-226	7/1/2004 2:41:24 PM	RE040701-1-1	7/04/2004 3:25:00 PM	7/13/2004 10:07:00 AM	SOLID	1 g	B10	Alpha Scan	RE040712-1A 7/13/2004	49.000 54.000	209.96%	15	-0.09	0.69	pCi/g	NA	NA	Y1,U,M
RE040701-1	Ra-226	7/1/2004 2:41:24 PM	RE040701-1-1	7/04/2004 3:25:00 PM	7/13/2004 10:40:00 AM	SOLID	0.995 g	A12	Alpha Scan	RE040712-1A 7/13/2004	2533.000 56.000	229.61%	15	42.6	0.6	pCi/g	NA	NA	88.4 P,M3
RE040701-2	Ra-226	7/8/2004 2:58:30 PM	RE040701-2-1	7/11/2004 7:53:00 PM	7/15/2004 10:21:00 AM	SOLID	3 g	B9	Alpha Scan	RE040714-1A 7/15/2004	75.000 82.000	241.21%	90	-0.011	0.068	pCi/g	NA	NA	U,M
RE040701-2	Ra-226	7/8/2004 2:58:30 PM	RE040701-2-1	7/16/2004 9:04:00 AM	7/18/2004 3:47:00 PM	SOLID	3 g	B13	Alpha Scan	RE040714-1A 7/18/2004	1199.000 22.000	213.79%	15	16.8	0.4	pCi/g	NA	NA	105 P,M3

Comments:

Data Package ID: REM0405097-1

Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- D - DER is greater than Control Limit of 2.13
- + - Duplicate RPD not within limits.
- LT - Result is less than Request MDC, greater than sample specific MDC
- * - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- # - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

Notes:

- 1) The Tracer results are not yield corrected (i.e. activity measured not activity added).
- 2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

- TR - Tracer TA - Target Analyte
- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- DER - Duplicate Error Ratio
- BDL - Below Detection Limit

Sample ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count			Sample Count		
				Start Date	Time (min.)	Dur. (min.)	Pos. Chk.	Start Date	Time
0406158.1D	2B	13	6	7/8/04	01:50:00	19	15	BP	7/8/04 14:23
↓ 11	1A	14	↓	09:41	24	BP	↓	14:50	15 BP
↓ 112	2B	1	7	09:55	11	BP	↓	16	↓
040628.1.MB	1A	2	↓	09:59	26	BP	↓	15:20	28 BP
↓ LCS	2B	3	↓	10:13	14	↓	↓	↓ 2489	↓
calib. source	1A	NA	↓	↓	↓	↓	↓	7-8-04 15:41	↓
↓	2B	NA	↓	↓	↓	↓	↓	15:46 9334	↓
↓	1A	↓	↓	↓	↓	↓	↓	↓	↓
↓	2B	↓	↓	↓	↓	↓	↓	↓	↓
0405096.1.DP	1A	4	7	7/11/04	19:51:16	90	BP	7/12/04 13:57	90 BP
↓ 12	2B	6	↓	↓	45	↓	↓	19:46 9417	↓
040611.1.NB	1A	8	↓	7-12-04	08:10:06	BP	↓	15:51 152	↓
↓ 12.11B	2B	9	↓	↓	50	↓	↓	54	↓
0405097-17	1A	10	↓	↓	09:42	20	15	15:32 42508	15
↓ -19	2B	12	↓	↓	↓	1	↓	↓	↓
calib. source	1A	NA	↓	↓	↓	↓	↓	30642	↓
↓	2B	NA	↓	↓	↓	↓	↓	↓	↓
0405097-19D	1A	13	7	7-13-04	07:45:15	15	BP	7-13-04 07:41	9658 1 BP
↓ -21	2B	14	↓	↓	6	↓	↓	07:42 9212	1 BP
↓ -22	1A	1	8	↓	08:03	28	↓	↓	↓
-23	2B	2	↓	↓	6	↓	↓	15:09 11754	31 BP
-24	1A	3	↓	↓	↓	↓	↓	13:52 1372	31 BP
-25	2B	4	↓	↓	↓	15	↓	13:46 28886	31 BP
							↓	15:18 15184	31 BP

Comments:

000056

Paragon Analytics, Inc.

Sample ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count			Sample Count		
				Start Date	Time	Counts (min.)	Pos. Chk.	Date	Time
0405097-28	1A	6	8	7.13.04	0842	23	15	BP	7.13.04
-29	213	8	↓	↓	16	↓	↓	↓	1437
-30	1A	9	↓	↓	0904	19	↓	↓	12073
R6040701-1M13	2B	10	↓	↓	54	↓	↓	↓	1455
-1LCS	1A	12	↓	↓	0924	56	↓	↓	13694
calib. Source	1A	NA	↓	↓	↓	↓	↓	↓	↓
	2B	↓	↓	↓	↓	↓	↓	↓	↓
	1A	NA	↓	↓	↓	↓	↓	↓	↓
	2B	NA	↓	↓	↓	↓	↓	↓	↓
0405097-1	1A	13	8	7.14.04	0819	99	15	BP	7.13.04
-1D4P	2B	14	8	↓	↓	162	↓	↓	15344
-2	1A	1	9	↓	↓	0837	73	↓	9516
-3	2B	2	9	↓	↓	63	↓	↓	15361
-4	1A	3	↓	↓	0855	142	↓	↓	1536
-5	2B	4	↓	↓	↓	50	↓	↓	9440
-6	TA	6	↓	↓	0922	107	↓	↓	1406
-7	2B	8	↓	↓	↓	32	↓	↓	1424
-8	1A	9	↓	↓	0944	75	↓	↓	19328
-9	2B	10	↓	↓	↓	33	↓	↓	21869
-10	1A	12	↓	↓	1005	41	↓	↓	1449
0405097-14	1A	10	10	7.13.04	2040	222	90	BP	223
-15	2B	12	10	↓	↓	95	↓	↓	271
-16	1A	8	10	7.13.04	0823	150	↓	↓	1509
									106
									906
									152
									160
									1544
									84
									939
									90
									BP
									383
									WT
									WT

Comments:

BP 7/19

000057

Sample ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count			Sample Count		
				Start Date	Time	Counts (min.)	Pos. Chk.	Date	Time
RE05097-2M3	2B	9	10	7/15.04	08:23	82	90	13P	7.15.04
0405097-10	1A	13	9			1005	47	15	14:50
↓ -10 Dmp	2B	14	9			↓ 61	15		187
↓ -12	1A	1	10			1025	54		1523
↓ -13	2B	2	10			↓ 43	14		162
↓ -16MS	1A	3				1046	30		15571494
↓ -18	2B	4				↓ 14	15		7935
↓ -20	1A	4	11	7.16.04	08:02	42	3P	216.04	13:02
↓ -26	2B	8				↓ 11	15		51237
↓ -27	1A	12				0819	20		15025
RE04070+2ES	2B	10				↓ 14			13:21
0405097-6	1A	3P	29			0835	168	90	1890
Calib Source	1A	7/19	NA						1979
↓	2B	NA							14:35
↓	1A								16:21
↓	2B								9438
↓	1A								1000
↓									4293
↓									1
↓									BP
0405097-27	1A	6	10	7/18/04	14:37	17	15	13P	14:34
RE05097-2-LCS	2B	13	↓			22	15	14:48	15
RE05097-1MB	1A	6	101	7/19/04	08:32	88	15	15:03	14:48
RE ↓ -2LCS	2B	14	10	7/19	↓	22	15	15:04	11:52
↓ 040618S-1	1A	1	11	↓	09:08	39	15	13:20	4:3
↓ -1 Dmp	2B	2	11	↓	18	15	15	13:20	401
↓ -1MS	2B	34	11	↓	09:24	224	15	13:55	359
									↓
									14:15
									2742

Comments:

MP 7/19 BP 7/19

Paragon Analytics

Radiochemistry ICP Worksheet

Prep Procedure: Ra226_RnE

Reviewed By: ATF

Review Date: 7/14/04

Reference Carrier

LabID	QC Type	Car Vol	Ref Carr Dil Vol	Ref Carr ICP Alq	Ref Carr ICP Dil Vol	Ref Carr ICP Run	Ref Carr ICP Conc	Ref Carr ICP Conc
RE040701-1	CAR	1	1001	1	10	IR040706-1A1	1.35167	

Samples

Prep Num	LabID	QC Type	Init Samp Alq (g)	Car Vol (ml)	Samp Dil Vol (ml)	Init ICP Dil Vol (ml)	Post Con Vol (ml)	Pre Sep Vol (ml)	Post Sep Vol (ml)	Fin ICP Dil Vol (ml)	Fin ICP Dil Vol (ml)	Initial ICP Run	Final ICP Run	Init ICP Conc (ug/ml)	Fin ICP Conc (ug/ml)	Init Samp Mass (ug)	Ref Mass (ug)	Flag	Fin Samp Mass (ug)	% Yield	Final Sample Alq
1	0405097-17	SMP	0.5484	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00552	0.52475	55.1448	13530.22	13249.94	97.53%	0.5457
1	0405097-19	SMP	0.28922	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.0041	0.55516	40.958	13530.22	14017.79	103.25%	0.2878
1	0405097-19	DUP	0.28922	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00394	0.57036	39.3606	13530.22	14401.59	106.13%	0.2878
1	0405097-21	SMP	0.25938	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00365	0.56601	36.4635	13530.22	14039.25	103.48%	0.2581
1	0405097-22	SMP	0.46511	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00472	0.56827	47.1528	13530.22	14298.32	105.31%	0.4578
1	0405097-23	SMP	0.46232	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00184	0.48715	18.3816	13530.22	12300.54	90.79%	0.4600
1	0405097-24	SMP	0.28967	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00177	0.57057	17.6823	13530.22	14066.39	106.34%	0.2882
1	0405097-25	SMP	1.01486	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00807	0.46865	80.6193	13530.22	11833.41	86.94%	1.010
1	0405097-28	SMP	0.22872	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00275	0.57723	27.4725	13530.22	14575.96	107.50%	0.2276
1	0405097-29	SMP	0.47411	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00809	0.55432	80.8191	13530.22	13996.58	102.83%	0.4717
1	0405097-30	SMP	0.47452	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.0065	0.50364	64.935	13530.22	12716.91	93.54%	0.4721
1	RE040701-1	MB	1	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00034	0.54557	3.3966	13530.22	13775.64	101.79%	0.9950
1	RE040701-1	LCS	1	1	1000	1	10	999	999	25	0.1	101	IR040706-1A1	IR040706-1A1	0.00028	0.55268	2.7972	13530.22	13450.17	99.39%	0.9950

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#	Sample Name	Ba	Y	Pb
108	I 0405169-8	1.6778		4.7254
109	F 0405169-8	.04549		8.5442
110	I 0405169-10	3.1977		H11.381
111	F 0405169-10	.56126		H20.822
112	I 0405169-12	1.4019		4.6933
113	F 0405169-12	.00734		8.6111
114	CCV	.45962		.50223
115	CCB	.00405		H.00994
116	I 0405169-13	.39253		4.4107
117	F 0405169-13	.00258		7.9202
118	I 0405215-1	1.4037		1.1134
119	F 0405215-1	.01624		1.8237
120	I 0405215-2	2.5480		1.2365
121	F 0405215-2	.14208		.63990
122	I 0405215-3	1.5085		1.2950
123	F 0405215-3	.01677		1.7679
124	I PB040625-1MB	.01095		1.0235
125	F PB040625-1MB	.00083		1.5932
126	CCV	.45646		.49638
127	CCB	.00386		H.00494
128	I PB040625-1LCS	.01190		1.0451
129	F PB040625-1LCS	.00082		1.6343
130	PB040625-1RC	.00006		.70086
131	CCV	.45711		.50765
132	CCB	.00365		H.00603
133	PB040625-1RC	-.00012		.76837
134	I 0405097-17	.00552		.02582
135	F 0405097-17	.52475		.00596
136	I 0405097-19	.00410		.01096
137	F 0405097-19	.55516		.00267
138	I 0405097-19D	.00394		.01102
139	F 0405097-19D	.57036		.00183
140	I 0405097-21	.00365		.01004
141	F 0405097-21	.55601		.00224
142	I 0405097-22	.00472		.00792
143	CCV	.47314		.48243
144	CCB	.00121		.00107
145	F 0405097-22	.56627		.00309
146	I 0405097-23	.00184		.00478
147	F 0405097-23	.48715		.00108
148	I 0405097-24	.00177		.01113
149	F 0405097-24	.57057		.00359
150	I 0405097-25	.00807		.01131
151	F 0405097-25	.46865		.00311
152	I 0405097-28	.00275		.01025
153	F 0405097-28	.57723		.00207
154	I 0405097-29	.00809		.01002
155	CCV	.47135		.48465
156	CCB	.00137		.00165
157	F 0405097-29	.55432		.00202
158	I 0405097-30	.00650		.00481
159	F 0405097-30	.50364		.00068
160	I RE040701-1MB	.00034		-.00108
161	F RE040701-1MB	.54557		-.00251

poor precision, sample
may not have been
mixed

Analysis Report

Averages

07/07/04 09:39:53 AM

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#	Sample Name	Ba	Y	Pb
162	I RE040701-1LCS	.00028		-.00122
163	F RE040701-1LCS	.53268		.00004
164	RE040701-1RC	1.3517		-.00114
165	CCV	.47230		.48224
166	CCB	.00147		.00119

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 5

**QUALITY ASSURANCE
SUMMARY REPORTS**

5

000062

Paragon Analytics

QUALITY ASSURANCE SUMMARY SHEET

278662

PAI W.O. # / BATCH 0405097 / RE040701-1
TEST ²²⁶Ra
METHOD 903.1
SOP/REV (PREP) 783 RS
SOP/REV (ANAL)

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

GJ 7/14/04

SAMPLES IN THIS BATCH WERE PREPARED IN THE FOLLOWING MANNER:

1. APPROXIMATELY 1 g OF DRIED, GROUND SOIL WAS ALIQUOTTED, DIGESTED AND PACKED FOR GAMMA ANALYSIS ACCORDING TO SOPS 773 AND 739.
2. AFTER GAMMA ANALYSIS WAS COMPLETE, THE SAMPLES WERE RELEASED FOR ANALYSIS. ALIQUOT SIZES WERE DETERMINED BASED ON EXPECTED Ra ACTIVITY AS DETERMINED FROM THE GAMMA ANALYSIS.
3. SAMPLES WERE ALIQUOTTED AND PROCESSED AS OUTLINED FOR WATER SAMPLES IN SOP 783.

THE SAMPLE EQUIVALENT MASSES WERE DETERMINED BY USING THE FORMULA:

$$\left(\frac{\text{INITIAL DIGESTED ALIQUOT (g)}}{1000 \text{ mL}} \right) * \text{ALIQUOT DIGESTATE (mL)} = \text{ALIQUOT FOR Ra (g)}$$

GJ 7/14/04

GJ 7/14/04

TECHNICIAN/ANALYST

DATE 7/14/04

DEPARTMENT MANAGER

Nicholas Sids

DATE 7/14/04

PARAGON ANALYTICS
Radiochemistry Data Package

Section 6

**LABORATORY
BENCH SHEETS**

6

Paragon Analytics

Radiochemistry Instrument Worksheet

Prep Batch: RE040704

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? Y N													
Prep Num	LabID	QC Type	Init Alq	Adj Alq	Units	Cnt Date	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts	Notes
1	0405097-17	SMP	0.5464	0.546660	g	15:32	A	10	20	7.1198	15m	42508	
1	0405097-19	SMP	0.28922	0.287775	g	✓	B	12	11	2.2417		306472	
1	0405097-19	DUP	0.28922	0.287775	g	13:51	A	13	15	2.2418		24408	
1	0405097-21	SMP	0.259375	0.258079	g	✓	B	14	6	2.3970		35063	
1	0405097-22	SMP	0.46011	0.457811	g	13:09	A	1	28	2.2394		11756	
1	0405097-23	SMP	0.46232	0.460010	g	✓	B	12	6	2.6656		13721	
1	0405097-24	SMP	0.289665	0.288218	g	13:46	A	3	31	2.6358		28686	
1	0405097-25	SMP	1.01486	1.00979	g	✓	B	4	15	2.4612		15184	
1	0405097-28	SMP	0.22872	0.227577	g	14:37	A	16	73	2.3248		24268	
1	0405097-29	SMP	0.47411	0.471741	g	✓	B	8	10	2.0138		12075	
1	0405097-30	SMP	0.47452	0.472149	g	14:55	A	9	19	2.5149		13694	
1	RE040701-1	MB	1	0.995004	g	✓	B	10	54	2.0996		49	
1	RE040701-1	LCS	1	0.995004	g	15:12	A	12	56	2.2961		2533	

Sample Collection Information																	
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID	Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID

T1	BARIUM	247918	16,023.189	ppm	NA	1 ppm	RS009	S1	RA-226	580.2613.34	106.908	DPM/ml	07/01/04	1 ml	RS009
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Paragon Analytics

Radiochemistry Instrument Worksheet

Prep Batch: RE04070-12

Prep Procedure: Ra226_RnE

Prep Num	LabID	QC Type	Init Atq	Fin Atq	Units	Cnt Date	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts	Notes
1	0405097-1	SMP	3.2217	3.2217	g								
1	0405097-1	DUP	3.196	3.196	g								
1	0405097-2	SMP	3.0583	3.0583	g								
1	0405097-3	SMP	3.812	3.812	g								
1	0405097-4	SMP	3.8572	3.8572	g								
1	0405097-5	SMP	3.6857	3.6857	g								
1	0405097-6	SMP	3.6562	3.6562	g								
1	0405097-7	SMP	3.1489	3.1489	g								
1	0405097-8	SMP	3.1187	3.1187	g								
1	0405097-9	SMP	3.7146	3.7146	g								
1	0405097-10	SMP	3.138	3.138	g								
1	0405097-10	DUP	3.1424	3.1424	g								
1	0405097-11	SMP	3.1093	3.1093	g								
1	0405097-12	SMP	3.0089	3.0089	g								
1	0405097-13	SMP	3.0698	3.0698	g								
1	0405097-14	SMP	3.4567	3.4567	g								
1	0405097-15	SMP	3.067	3.067	g								
1	0405097-16	MS	3.6249	3.6249	g								
1	0405097-18	SMP	3.8098	3.8098	g								
1	0405097-20	SMP	3.0759	3.0759	g								
1	0405097-26	SMP	3.1483	3.1483	g								
1	0405097-27	SMP	3.3821	3.3821	g								
1	RE040701-2	MB	3	3	g								
1	RE040701-2	LCS	3	3	g								

Analytical QASS / NCR? Y / N

✓

Paragon Analytics

Radiochemistry Instrument Worksheet

Prep Batch #: RnE640701-2

Prep Procedure: Ra226_RnE

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date	Detector ID	Flask ID	Total Blg Counts	Efficiency	Count Duration	Gross Counts	Notes

Analytical QASS / NCR? Y / <input checked="" type="checkbox"/> N <input type="checkbox"/>													
Spike Solution Information													
Solv# Nuclide SolnID Prep Conc Units Prep Date Aliquot Units Pipet ID													
S1 RA-226 580.2613.34 106.907 DF/mL 07/08/04 1 ml RS009													

Paragon Analytics

Radiochemistry Instrument Worksheet

Prep Batch: RE0407012

Prep Procedure: Ra226_RnE

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date	Detector ID	Flask ID	Total Blg Counts	Efficiency	Count Duration	Gross Counts	Analytical QASS / NCR? Y/N	
													Time	Notes
1	0405097-1	SMP	3.2217	3.2217	g	9/1/14 06:46	A	13	991	2.2478	15m	19361		
1	0405097-1	DUP	3.196	3.196	g	9/1/14 06:46	B	14	162	2.3910		21415		
1	0405097-2	SMP	3.0583	3.0583	g	9/1/14 24:00	A	1	73	2.2364		19328		
1	0405097-3	SMP	3.812	3.812	g	9/1/14 24:00	B	2	63	2.656		21869		
1	0405097-4	SMP	3.8572	3.8572	g	9/1/14 49:00	A	3	142	2.6358		223		
1	0405097-5	SMP	3.6857	3.6857	g	9/1/14 49:00	B	4	500	2.4692		271		
1	0405097-6	SMP	3.6562	3.6562	g	9/1/14 49:00	A	96	187	168	2.5149	90m	721	
1	0405097-7	SMP	3.1489	3.1489	g	9/1/14 51:01	B	8	32	2.0138	15m	946		
1	0405097-8	SMP	3.1187	3.1187	g	9/1/14 51:01	A	9	75	2.5149		152		
1	0405097-9	SMP	3.7146	3.7146	g	9/1/14 51:01	B	10	33	2.0996		100		
1	0405097-10	SMP	3.138	3.138	g	9/1/14 51:01	A	13	41	2.2478		118		
1	0405097-10	DUP	3.1424	3.1424	g	9/1/14 51:01	B	14	61	2.3910		187		
1	0405097-11	SMP	3.1093	3.1093	g	9/1/14 51:44	A	12	41	2.2961		84		
1	0405097-12	SMP	3.0089	3.0089	g	9/1/14 51:23	A	1	54	2.2394		144		
1	0405097-13	SMP	3.0598	3.0598	g	9/1/14 51:23	B	2	43	2.6656		1672		
1	0405097-14	SMP	3.4567	3.4567	g	9/1/14 51:23	A	10	222	2.1198	90m	939		
1	0405097-15	SMP	3.07	3.07	g	9/1/14 51:23	B	12	95	2.2417		383		
1	0405097-16	SMP	3.0221	3.0221	g	9/1/14 51:15	A	8	150	2.1225		362		
1	0405097-16	MS	3.6249	3.6249	g	9/1/14 51:57	A	3	30	2.6358	15m	1494		
1	0405097-18	SMP	3.8098	3.8098	g	9/1/14 51:03	B	4	14	2.4692		7935		
1	0405097-20	SMP	3.0759	3.0759	g	9/1/14 51:03	A	4	42	2.5025		51237		
1	0405097-26	SMP	3.1483	3.1483	g	9/1/14 51:03	B	8	11	2.0138		15025		
1	0405097-27	SMP	3.3821	3.3821	g	9/1/14 51:03	A	4	17	2.5248		14948		
1	RE040701-2	MB	3	3	g	9/1/14 51:15	B	9	82	2.4121	90m	75		
1	RE040701-2	LGS	3	3	g	9/1/14 51:03	B	13	22	2.1319	15m	1199		

DRAFT

Paragon Analytics**Radiochemistry Instrument Worksheet**

Prep Batch: RE0407012

Prep Procedure: Ra226_RnE

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts	Notes

Analytical QASS / NCR? Y / N													
<input type="checkbox"/>													
<input type="checkbox"/>													
<input type="checkbox"/>													

Spike Solution Information													
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot Units	Pipet ID						
S1	RA-226	580.2613.34	106.907	DPM/ml	07/08/04	1	mL						RS009

DRAFT

000063

Paragon Analytics

Radiochemistry Prep Worksheet

Prep Procedure: Ra226_RnE

Reviewed By: ATF *A* Review Date: 7/14/04

Non-Routine Pre-Treatment? <input checked="" type="checkbox"/>	N	Batch: <u>QNS55-178662</u>	Re-Prep? <input checked="" type="checkbox"/>	Y <i>16</i>	Batch: <u>NA</u>	Reviewed By: ATF <i>A</i>
Prep SOP: PAI 783	Rev: 5	Prep Analyst: Adrienne Freda	Prep QASS / NCR? <input checked="" type="checkbox"/>	<u>Y</u>	Prep QASS / NCR? <i>Y</i>	Review Date: <u>7/14/04</u>
Prep SOP: NONE		Prep Date: 7/1/04				
Matrix Class: solid		Prep Dept: RS				

Prep Notes

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq g	Fin Aliq g	Prep Basis	Ingrowth Date/Time	Decay Date/Time	Standards	
1	1	0405097-17	SMP	<u>1</u>	0.5684	0.565660	Dry Weight	07/04/04 14:53	07/12/04 10:26	T1	
2	1	0405097-19	SMP	<u>1</u>	0.28922	0.287775	Dry Weight	07/04/04 14:53	07/12/04 10:26	T1	
3	1	0405097-19	DUP	<u>1</u>	0.28922	0.287775	Dry Weight	07/04/04 14:53	07/13/04 08:29	T1	
4	1	0405097-21	SMP	<u>1</u>	0.256375	0.256079	Dry Weight	07/04/04 14:53	07/13/04 08:29	T1	
5	1	0405097-22	SMP	<u>1</u>	0.46011	0.457811	Dry Weight	07/04/04 14:53	07/13/04 08:47	T1	
6	1	0405097-23	SMP	<u>1</u>	0.46232	0.460010	Dry Weight	07/04/04 14:53	07/13/04 08:47	T1	
7	1	0405097-24	SMP	<u>1</u>	0.289665	0.288218	Dry Weight	07/04/04 14:53	07/13/04 09:15	T1	
8	1	0405097-25	SMP	<u>1</u>	1.01486	1.00979	Dry Weight	07/04/04 15:25	07/13/04 09:15	T1	
9	1	0405097-28	SMP	<u>1</u>	0.22872	0.227577	Dry Weight	07/04/04 15:25	07/13/04 09:40	T1	
10	1	0405097-29	SMP	<u>1</u>	0.47111	0.471141	Dry Weight	07/04/04 15:25	07/13/04 09:40	T1	
11	1	0405097-30	SMP	<u>1</u>	0.47452	0.472149	Dry Weight	07/04/04 15:25	07/13/04 10:07	T1	
12	1	RE040701-1	MB	<u>1</u>	0.995004	0.995004	Dry Weight	07/04/04 15:25	07/13/04 10:07	T1	
13	1	RE040701-1	LCS	<u>1</u>	0.995004	0.995004	Dry Weight	07/04/04 15:25	07/13/04 10:40	T1,S1	

Spiked By: Adrienne Freda Date: 7/1/04 Relinquished By: *A*Witnessed By: Scott Hafeman Date: 7/1/04 Date: 7/14/04Received By: *A* Date: 7/14/04

Paragon Analytics

Radiochemistry Prep Worksheet

Prep Procedure: Ra226_RnE

Non-Routine Pre-Treatment? Y N

Reviewed By: ATF 

Review Date: 7/19/04

Prep SOP: PAI 783 Rev: 5

Prep SOP: NONE

Matrix Class: solid

Re-Prep? Y N

Batch: 

Prep QASS / NCR? Y N


Prep Analyst: Adrienne Freda

Prep Date: 7/8/04

Prep Dept: RS

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Ingrowth Date/Time	Decay Date/Time	Standards	Prep Notes
1	1	0405097-1	SMP	963	3.2217	3.2217	Dry Weight	07/11/04 18:54	07/14/04 08:52		
2	1	0405097-1	DUP	911	3.196	3.196	Dry Weight	07/11/04 19:11	07/14/04 08:52		
3	1	0405097-2	SMP	T8	3.0583	3.0583	Dry Weight	07/11/04 18:54	07/14/04 08:52		
4	1	0405097-3	SMP	955	3.812	3.812	Dry Weight	07/11/04 18:54	07/14/04 08:52		
5	1	0405097-4	SMP	8824	3.8572	3.8572	Dry Weight	07/11/04 18:54	07/14/04 08:52		
6	1	0405097-5	SMP	995	3.6857	3.6857	Dry Weight	07/11/04 18:54	07/14/04 08:52		
7	1	0405097-6	SMP	L17	3.6562	3.6562	Dry Weight	07/11/04 09:57	07/16/04 10:32		
8	1	0405097-7	SMP	988	3.1489	3.1489	Dry Weight	07/11/04 19:11	07/14/04 09:57		
9	1	0405097-8	SMP	T2	3.1187	3.1187	Dry Weight	07/11/04 19:11	07/14/04 10:19		
10	1	0405097-9	SMP	961	3.7146	3.7146	Dry Weight	07/11/04 19:11	07/14/04 10:19		
11	1	0405097-10	SMP	T20	3.138	3.138	Dry Weight	07/11/04 19:11	07/15/04 10:50		
12	1	0405097-10	DUP	981	3.1424	3.1424	Dry Weight	07/11/04 18:54	07/15/04 10:50		
13	1	0405097-11	SMP	F19	3.1093	3.1093	Dry Weight	07/11/04 19:11	07/14/04 10:43		
14	1	0405097-12	SMP	T70	3.0089	3.0089	Dry Weight	07/11/04 19:11	07/15/04 11:23		
15	1	0405097-13	SMP	994	3.0698	3.0698	Dry Weight	07/11/04 19:32	07/15/04 11:23		
16	1	0405097-14	SMP	T9	3.4567	3.4567	Dry Weight	07/11/04 19:32	07/15/04 08:51		
17	1	0405097-15	SMP	920	3.067	3.067	Dry Weight	07/11/04 19:32	07/15/04 08:51		
18	1	0405097-16	SMP	T22	3.0221	3.0221	Dry Weight	07/11/04 19:32	07/15/04 10:21		
19	1	0405097-16	MS	T24	3.6249	3.6249	Dry Weight	07/11/04 19:32	07/15/04 11:57	S1	
20	1	0405097-18	SMP	A6	3.8098	3.8098	Dry Weight	07/11/04 19:32	07/15/04 11:57		
21	1	0405097-20	SMP	908	3.0759	3.0759	Dry Weight	07/11/04 19:32	07/16/04 08:38		
22	1	0405097-26	SMP	927	3.1483	3.1483	Dry Weight	07/11/04 19:53	07/16/04 08:38		
23	1	0405097-27	SMP	X5	3.3821	3.3821	Dry Weight	07/16/04 08:04	07/18/04 15:47		
24	1	RE040701-2	MB	949	3	3	Dry Weight	07/11/04 19:53	07/15/04 10:21		
25	1	RE040701-2	LCS	916	3	3	Dry Weight	07/16/04 08:04	07/18/04 15:47	S1	

Spiked By: Adrienne Freda

Date: 7/8/04

Witnessed By: Nick Tisch

Date: 7/8/04

Retirquished By:

Date: 7/19/04

Received By:

Date: 7/26/04

Date: 7/26/04

Spiked Solution Information											
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID	DPM/ml	Date:	Comments
S1	RA-226	580	26.13.34	106.907	07/08/04	1	ml	RS009			

Paragon Analytics

Radiochemistry Prep Worksheet

Prep Procedure: Ra226_RnE

Prep Batch Not Validated!!!

Reviewed By: _____

Review Date: _____

Prep SOP: PAI 783 Rev: 5
 Prep SOP: NONE
 Matrix Class: solid

Non-Routine Pre-Treatment? Y / N Batch: _____

Re-Prep? Y / N

Batch: _____

Reviewed By: _____

Review Date: _____

Prep Analyst: Adrienne Freda *AF*
 Prep Date: 7/18/04 7/8/04
 Prep Dept: RS Q13(CM)

Prep QASS / NCR? Y / N _____

Prep Notes

Samp Num	Prep Num	LabID	QC	Dish	Type	No.	g	g	Init Alq	Fin Alq	Prep Basis	Ingrowth Date/Time	Decay Date/Time	Standards
1	1	0405097-1	SMP	963	3.2217	2	Dry Weight	1.1115 <i>10^4</i>	1.1115 <i>10^4</i>	1.1115 <i>10^4</i>	7/18/04	7/18/04		
2	1	0405097-1	DUP	911	3.196	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
3	1	0405097-2	SMP	78	3.0583	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
4	1	0405097-3	SMP	955	3.812	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
5	1	0405097-4	SMP	8824	3.8572	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
6	1	0405097-5	SMP	995	3.6857	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
7	1	0405097-6	SMP	117	3.6862	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
8	1	0405097-7	SMP	988	3.1489	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
9	1	0405097-8	SMP	72	3.1187	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
10	1	0405097-9	SMP	961	3.7146	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
11	1	0405097-10	SMP	20	3.138	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
12	1	0405097-10	DUP	981	3.1424	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
13	1	0405097-11	SMP	F19	3.1093	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
14	1	0405097-12	SMP	T10	3.0089	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
15	1	0405097-13	SMP	994	3.0698	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
16	1	0405097-14	SMP	T9	3.4667	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
17	1	0405097-15	SMP	920	3.07	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
18	1	0405097-16	SMP	T22	3.0221	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
19	1	0405097-16	MS	T24	3.6249	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
20	1	0405097-18	SMP	A6	3.8098	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
21	1	0405097-20	SMP	908	3.0759	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
22	1	0405097-26	SMP	927	3.1483	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
23	1	0405097-27	SMP	X6	3.3821	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
24	1	RE040701-2	MB	949	3	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		
25	1	RE040701-2	LCS	916	3	2	Dry Weight	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	1.1854 <i>10^4</i>	7/18/04	7/18/04		

DRAFT

Spiked By: Adrienne Freda *AF*
 Date: 7/18/04
 Witnessed By: *AT*
 Date: 7/18/04

Relinquished By: _____
 Date: _____

Received By: _____
 Date: _____

Spike Solution Information														
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID						
S1	RA-226	580.2613.34	106.908	DPm/ml	07/01/04	1	ml	RS009						

Comments: 000073

Paragon Analytics

Radiochemistry Prep Worksheet

Prep Batch: REU40701-2

Prep Procedure: Ra226_RnE

Prep Batch Not Validated!!!

Reviewed By:

Non-Routine Pre-Treatment? Y / N

Batch:

Re-Prep? Y / N

Batch:

Prep SOP: PAI 783 Rev: 5

Prep SOP: NONE

Matrix Class: solid

Prep Analyst: Adrienne Freda

Prep Date: 7/1/04

Prep Dept: RS

Reviewed By:

Review Date:

Prep QASS / NCR? Y / N

Balance: 18 100 11800

Balance: 13 000 11800

Samp Num	Prep LabID	QC Type	Dish q163)	Init Alq g	Fin Alq g	Prep Basis	Ingrowth Date/Time	Decay Date/Time	Standards	Prep Notes
1	1	0405097-1	SMP 20173	2.22172		Dry Weight				
2	1	0405097-1	DUP 911	2.19602		Dry Weight				
3	1	0405097-2	SMP 20173	2.05832		Dry Weight	Disk T8			
4	1	0405097-3	SMP 20173	2.01202		Dry Weight	7-26-995 955			
5	1	0405097-4	SMP 88741	2.05722		Dry Weight				
6	1	0405097-5	SMP 905	2.08172		Dry Weight				
7	1	0405097-6	SMP 20173	2.06522		Dry Weight	L17			
8	1	0405097-7	SMP 20173	2.01992		Dry Weight	988			
9	1	0405097-8	SMP T2	2.01872		Dry Weight				
10	1	0405097-9	SMP 9161	2.07462		Dry Weight				
11	1	0405097-10	SMP T20	2.015702		Dry Weight				
12	1	0405097-10	DUP A23	2.014242		Dry Weight	981			
13	1	0405097-11	SMP 20173	2.00932		Dry Weight	ST F19			
14	1	0405097-12	SMP T10	2.00092		Dry Weight				
15	1	0405097-13	SMP 914	2.00982		Dry Weight				
16	1	0405097-14	SMP T9	2.01572		Dry Weight				
17	1	0405097-15	SMP 20173	2.006102		Dry Weight	920			
18	1	0405097-16	SMP T23	2.0212		Dry Weight				
19	1	0405097-16	MS T24	2.02102		Dry Weight	S1			
20	1	0405097-18	SMP A6	2		Dry Weight				
21	1	0405097-20	SMP 908	2		Dry Weight				
22	1	0405097-26	SMP 927	2		Dry Weight				
23	1	0405097-27	SMP X5	2		Dry Weight				
24	1	RE040701-2	MB 949	2		Dry Weight				
25	1	RE040701-2	LCS 916	2		Dry Weight	S1			

Spiked By: Adrienne Freda Date:

Witnessed By: _____ Date: _____

11/10/04

Relinquished By: _____ Date: _____

Received By: _____ Date: _____

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date
S1	RA-226	580-2613-34	106.908	DPM/ml	07/01/04 1 ml

Comments

000074

SAMPLE CONDITION FORM (LIQUID)

ANALYST: *[Signature]*

ANALYSIS DATE: 7/1/04

METHOD: FEM

000075

SAMPLE CONDITION FORM (SOLIDS)

ANALYST:

ANALYSIS DATE: 7/7/04

METHOD: REM

000076

PARAGON ANALYTICS
Radiochemistry Data Package

Section 7

**STANDARDS
TRACEABILITY
DOCUMENTS**

7

Prepare a working level spiking solution at approximately 50 pCi/ml by diluting 580.1808.69 with 1.4M HCl

1) Determine the density of 1.4M HCl

$$\begin{array}{l} \text{Mass of empty Class A volumetric flask} \quad 62.4702 \text{ g Ba/413} \\ \text{Mass of flask + 100 ml 1.4M HCl} \quad 164.4606 \text{ g } \\ \text{Net mass of 1.4M HCl} \quad 101.9904 \text{ g} \end{array}$$

Lot = H613 X41A11

$$P = 1.01993 \text{ ml}$$

2) Transfer 580.1808.69 into 1L Bottle

$$\begin{array}{l} \text{Mass of empty 1L bottle w/o lid} \quad 74.2507 \text{ g Ba/413} \\ \text{Mass of 1L bottle + Standard} \quad 79.2699 \text{ g } \\ \text{Net mass of standard transferred} \quad 5.0192 \text{ g} \end{array}$$

3) Add 1.4M HCl to final dilution

$$\begin{array}{l} \text{Mass of empty 1L bottle w/o lid from above} \quad 74.2507 \text{ Ba/413} \\ \text{Mass of bottle, std + 1.4M HCl} \quad 1054.7 \text{ Ba/413} \\ \text{Net mass of std + 1.4M HCl} \quad 980.4493 = 980.4 \end{array}$$

4) Final Activity Calculation

$$\frac{(2729 \text{ Ba/g})(60 \frac{\text{dpm}}{\text{g}})(5.0192 \text{ g})(1.01993 \text{ ml})}{(40.3256 \text{ g})(980.4493)} = 107.50 \frac{\text{dpm}}{\text{ml}}$$

AG 12/23/03
Stnd ID: 580.2613.34

Description: Ra-226

Expiration: 12/15/04

Activity: 107.50 dpm/mL

12s Uncertainty: 0.85 dpm/mL

Ref. Date: 9/9/91

Ref Time: N/A

Prep Date: 12/15/03 Prep by: CRW

Matrix/Comp. 1.4 M HCl

Half Life (y): 1.60E+03

RG 12/23/03

12/15/03

Continued on Page

Read and Understood By

Carol Wayb

Signed

12/15/03
Date

Diane Hollings

Signed

12/23/03
Date

000078

(6/6/01)

Ref Date : 9-9-91

Prepare a primary dilution of Ra²²⁶. Transfer RSO # 580 (SRM 4967) to a 40 ml VOA vial and dilute to capacity with 1.4 M HCl.

1) Determine ^{RLF} mass of standard transferred

$$\begin{aligned} \text{Mass of ampule (opened) + beaker} &= 40.5099 \\ \text{Mass of empty ampule + beaker} &= 35.7393 \\ \text{Net Mass of Standard transferred} &= 5.0706 \text{ g} \end{aligned}$$

2) Dilute standard to final volume with 1.4M HCl

$$\begin{aligned} \text{Mass of empty VOA vial w/lid} &= 27.3231 \text{ g} \\ \text{VOA + Std. + 1.4M HCl} &= 67.16486 \text{ g} \\ \text{Final mass of primary std.} &= 40.3250 \text{ g} \end{aligned}$$

3) Final Activity calculation

$$\frac{(27.329 \text{ g/g})(60 \text{ dpm})}{40.3250 \text{ g}} (5.0706 \text{ g})(1.0219 \text{ g/ml}) = 21,039.8 \text{ dpm/ml}$$

Density of 1.4M HCl = 1.0219 g/ml. For calculation, see p.70 (Notebook 1808)

Added after "Z" out! [RG 4/28/03 - May require NCR]
Standard Reverified: 3/28/03 [for ICP work!]

Expires: 3/28/2004

RG
7/10/01

Reverified: 2/15/02
Expires: 2/15/03
RG 10/21/02

Continued on Page

Read and Understood By

R. Foul

Signed

6/6/01
Date

Benedict Kelley Jr.
Signed

7/10/01
Date

• 000079



National Institute of Standards & Technology
PAI EP 00580
Certificate recd 5-07-01

Standard Reference Material 4967
Radioactivity Standard

Radionuclide	Radium-226 ^{(1)*}
Source identification	SRM 4967
Source description	Liquid in a 5-mL, flame-sealed NIST borosilicate-glass ampoule ⁽²⁾
Solution composition	Approximately 1.4 mol•L ⁻¹ HCl ⁽³⁾ containing 1.74 mg BaCl ₂ per gram of solution ⁽⁴⁾ and Ra ⁺² ⁽⁵⁾
Solution density	1.019 ± 0.001 g•mL ⁻¹ at 22 °C ⁽⁶⁾
Solution mass	5.1167 ± 0.0027 g ⁽⁷⁾
Radium-226 activity concentration	2729 Bq•g ⁻¹ ⁽⁸⁾
Reference time	1200 EST 9 September 1991
Overall uncertainty	1.18 percent ⁽⁹⁾
Half life	1600 ± 7 years ⁽¹⁰⁾
Calibration method	NIST pressurized "4π"γ ionization chamber "A" calibrated with the national radium standards ⁽¹¹⁾ ; and confirmatory measurements ⁽¹²⁾

This standard reference material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD
January 1992

William P. Reed, Chief
Standard Reference Materials Program

*Notes on back

000080

NOTES

(¹) This standard was prepared by gravimetric dilutions of the "1947 series" of ^{226}Ra standards which were recalibrated at NIST (NBS) in 1967. The "age" of the radium, with accompanying in-growth of ^{210}Pb , is at least 44.3 years.

(²) Approximately five milliliters of solution. Ampoule specifications:

body diameter	16.5 ± 0.5 mm
wall thickness	0.60 ± 0.04 mm
barium content	less than 2.5 percent
lead oxide content	less than 0.02 percent
other heavy elements	trace quantities

(³) Corresponding to a 14.9% (by weight) solution of NIST, high-purity, vacuum-distilled hydrochloric acid (nominal $10 \text{ mol} \cdot \text{L}^{-1}$) in doubly-distilled water.

(⁴) The BaCl_2 reagent used to prepare the carrier solution was measured in a $\text{NaI}(\text{Tl})$ well counter and found to contain $\leq 0.01 \text{ Bq } ^{226}\text{Ra}$ per gram of BaCl_2 .

(⁵) The atom ratio of barium carrier to radium in the solution is approximately 2.5×10^4 .

(⁶) The uncertainty in the density is three times the standard deviation of the mean for three independent gravimetric determinations. Confirmatory measurements based on the total master solution mass and individually dispensed masses in known volumes were in agreement.

(⁷) Mean mass of the dispensed solution in the ampoule. The uncertainty is three times the standard deviation of 19 individually weighed masses of solution from which the mean mass was calculated.

(⁸) Corresponding to $7.461 \times 10^{-8} \text{ g } ^{226}\text{Ra}$ per gram of solution assuming a conversion factor of $36.576 \text{ kBq} \cdot \mu\text{g}^{-1}$.

(⁹) The overall uncertainty, 1.18 percent, was formed by taking three times the quadratic combination of the standard deviation of the mean, or approximations thereof, for the following component uncertainties:

a) four ion chamber "A" measurements on samples of 2 dilutions	0.051 percent
b) twenty-two comparative ion chamber "A" measurements on 8 "1947(1967 recalibrated) series" of ^{226}Ra standards	0.040 percent
c) ion chamber calibration for the "1947(1967 recalibrated) series" [with respect to the "radiation balance" primary measurements on the "1957 series" and national radium standards (see note 11)]	0.34 percent
d) gravimetric dilution factor	0.1 percent
e) half-life correction	0.0046 percent
f) ^{226}Ra mass to activity conversion	0.16 percent

(¹⁰) NCRP Report No. 58, 2nd ed., Appendix A3 (Feb. 1985).

(¹¹) For further details on NIST (NBS) radium series calibrations see W.B. Mann, et al., J. Res. NBS 62, 21-26 (1959). The 1967 recalibration of the "1947 series" and "1957 series" intercomparisons were made with chamber "A".

(¹²) For confirmation, this ^{226}Ra standard series was also directly compared against preparations of the "1947" (1967 recalibration), "1978", and "1984" ^{226}Ra series by ^{222}Rn analyses with the NIST pulse-ionization-chamber Primary Radon Measurement System [R. Collé, et al., J. Res. NIST 95 155-165 (1990); J.M.R. Hutchinson, et al., Appl. Rad. Isot. 43, 175-189 (1992)], by liquid scintillation counting, and by $\text{NaI}(\text{Tl})$ well-crystal and Ge γ -spectrometry.

For further information please contact R. Collé, (301) 975-5527.

000081

PARAGON ANALYTICS
Radiochemistry Data Package

Section 8

CHAIN OF CUSTODY

8

000082

Paragon Analytics

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 0405097

Client Name: Kent & Sullivan Inc.

Client Project Name: Ross Adams

Client Project Number:

Client PO Number:

Client Sample	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
HR-01	0405097-1		SOLID	06-May-04	19:00
MR-01	0405097-2		SOLID	07-May-04	13:30
MR-02	0405097-3		SOLID	07-May-04	13:20
GR-01	0405097-4		SOLID	07-May-04	13:11
GR-02	0405097-5		SOLID	07-May-04	13:38
GR-03	0405097-6		SOLID	07-May-04	14:00
GR-04	0405097-7		SOLID	07-May-04	14:20
GR-05	0405097-8		SOLID	07-May-04	14:38
GR-06	0405097-9		SOLID	07-May-04	14:58
GR-07	0405097-10		SOLID	07-May-04	15:10
GR-08	0405097-11		SOLID	07-May-04	15:10
GR-09	0405097-12		SOLID	07-May-04	15:20
GR-10	0405097-13		SOLID	07-May-04	15:35
QM-01	0405097-14		SOLID	03-May-04	13:40
QM-02	0405097-15		SOLID	03-May-04	14:00
QM-03	0405097-16		SOLID	03-May-04	14:20
300-01	0405097-17		SOLID	04-May-04	9:50
300-02	0405097-18		SOLID	07-May-04	16:30
700-01	0405097-19		SOLID	07-May-04	17:00
700-02	0405097-20		SOLID	07-May-04	17:30
700-03	0405097-21		SOLID	07-May-04	17:20
700-04	0405097-22		SOLID	07-May-04	18:00
900-01	0405097-23		SOLID	07-May-04	13:00
900-02	0405097-24		SOLID	07-May-04	12:10
900-03	0405097-25		SOLID	07-May-04	12:30
900-04	0405097-26		SOLID	07-May-04	19:00
900-05	0405097-27		SOLID	07-May-04	18:40
OSA-01	0405097-28		SOLID	06-May-04	14:00
OSA-02	0405097-29		SOLID	06-May-04	19:00
OSA-03	0405097-30		SOLID	06-May-04	17:00



Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1522 Fax (970) 490-1522

Accession Number (LAB ID) 0410297 Date _____ Page 6 of 9

Chain-of-Custody

Project Name / No.:	Sampler(s):	(circle one) Turnaround: Standard or Rush (Due Date)				Dispose or Return to Client	
		(circle one)					
Report To:		Date	Time *	Lab ID	Matrix	No. of Contaminers	circle method or specify under comments
Phone:		2004					
Fax:		5-7	1330	2	RK	3	
Company:		5-7	1320	3	RK	3	
Address:							
Comments:							

Sample ID	Date	Time *	Lab ID	Matrix	No. of Contaminers	circle method or specify under comments
GR-01	5-7	1311	4	RK	1	
GR-02		1338	5		1	
GR-03		1400	6		1	
GR-04		1420	7		1	
GR-05		1438	8		1	
GR-06		1458	9		1	
GR-07		1510	10		1	

Relinquished By:	
(1)	Signature <u>Geno L. DeJarnach</u>
Printed Name <u>Geno DeJarnach</u>	Time <u>10:50</u>
Date <u>5-10-04</u>	Time <u>10:50</u>
Company <u>Kent + Sollars</u>	Company _____
Received By:	
(1)	Signature <u>John D. Sollars</u>
Printed Name <u>John D. Sollars</u>	Time <u>10:55</u>
Date <u>5-10-04</u>	Time <u>10:55</u>
Company <u>Paragon Analytics</u>	Company _____

Relinquished By:	
(2)	Signature _____
Printed Name _____	Time _____
Date _____	Time _____
Company _____	Company _____

* Time 7 min / sample ** Indicate specific analytes under comments.

Form 20214.xls (1/3/01)

Distribution: white / yellow (Paragon); pink retained by originator.



Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1522 Fax

Chain-of-Custody

Accession Number (LAB ID)

Page 7 of 9

Project Name / No.: _____

Report To:

Phone:

Fax:

Company:

Address:

Sampler(s): _____

(circle one) Turnaround: Standard or Rush (Due) Dispose or Return to Client

Sample ID	Date	Time *	Lab ID	Matrix	No. of Contaminers	Comments	Relinquished By:	
							(1)	(2)
GR-08	5-7	1510	11	RK	1		Signature <u>Gerald Warrich</u> Printed Name <u>Gerald Warrich</u> Date <u>5-10-04</u> Time <u>10:00</u> Company <u>Kent & Sullivan</u>	
GR-09		1520	12	/				
GR-10		1535	13	/				
QM-01	5-3	1340	14	RK	1			
QM-02		1400	15	/				
QM-03		1420	16	/				
300-01	5-4	0950	17	RK	1			
300-02	5-7	1630	18	RK	1			

Comments:

Received By:	(1)
Signature	<u>Chris Wolf</u>
Printed Name	<u>Chris Wolf</u>
Date	<u>5/11/04</u>
Time	<u>1645</u>
Company	<u>Paragon Analytics Company</u>
Received By:	(2)
Signature	<u>John Kent</u>
Printed Name	<u>John Kent</u>
Date	<u>5/11/04</u>
Time	<u>1645</u>
Company	<u>Paragon Analytics Company</u>

Distribution: white / yellow (Paragon); pink retained by originator

Form 2024.xls (1/3/01)

* Time 7 am ----- EST CEST MET DST

** Indicate specific analyses under comments.



Paragon Analytics, Inc.

2225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) C16251 Date 8/9/09 Page 8 of 9
study

Chain-of-Custody

Project Name / No.: Sampler(s):

Report To:

הנְּצָרָה

FILE:

Fax: _____
Company: _____
Address: _____

Project Name / No.:	Sampler(s):	(circle one) Turnaround: Standard or Rush (Due _____)										Dispose or Return to Client																																																																																																																																									
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<table border="1"> <thead> <tr> <th rowspan="2">Sample ID</th> <th rowspan="2">Date</th> <th rowspan="2">Time *</th> <th rowspan="2">Lab ID</th> <th rowspan="2">Matrix</th> <th rowspan="2">No. of Containers</th> <th colspan="7">circle method or specify under comments</th> </tr> <tr> <th colspan="7">Comments</th> </tr> </thead> <tbody> <tr> <td>700-01</td> <td>5-7</td> <td>1700</td> <td>19</td> <td>RK</td> <td>3</td> <td colspan="7">C Hold analysis pending metal results from samples</td> </tr> <tr> <td>700-02</td> <td>5-7</td> <td>1730</td> <td>20</td> <td>RK</td> <td>1</td> <td colspan="7">700-03 900-04 900-01 900-02 900-03 900-04 900-05</td> </tr> <tr> <td>700-03</td> <td>5-7</td> <td>1720</td> <td>21</td> <td>RK</td> <td>3</td> <td colspan="7"></td> </tr> <tr> <td>700-04</td> <td>5-7</td> <td>1800</td> <td>22</td> <td>RK</td> <td>1</td> <td colspan="7"></td> </tr> <tr> <td>900-01</td> <td>5-7</td> <td>1300</td> <td>23</td> <td>RK</td> <td>3</td> <td colspan="7"></td> </tr> <tr> <td>900-02</td> <td>5-7</td> <td>1210</td> <td>24</td> <td>/</td> <td>1</td> <td colspan="7"></td> </tr> <tr> <td>900-03</td> <td></td> <td>1230</td> <td>25</td> <td>/</td> <td>1</td> <td colspan="7"></td> </tr> <tr> <td>900-04</td> <td></td> <td>1900</td> <td>26</td> <td>/</td> <td>1</td> <td colspan="7"></td> </tr> <tr> <td>900-05</td> <td></td> <td>1840</td> <td>27</td> <td>/</td> <td>1</td> <td colspan="7"></td> </tr> </tbody> </table>													Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers	circle method or specify under comments							Comments							700-01	5-7	1700	19	RK	3	C Hold analysis pending metal results from samples							700-02	5-7	1730	20	RK	1	700-03 900-04 900-01 900-02 900-03 900-04 900-05							700-03	5-7	1720	21	RK	3								700-04	5-7	1800	22	RK	1								900-01	5-7	1300	23	RK	3								900-02	5-7	1210	24	/	1								900-03		1230	25	/	1								900-04		1900	26	/	1								900-05		1840	27	/	1							
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700-03	5-7	1720	21	RK	3																																																																																																																																																
700-04	5-7	1800	22	RK	1																																																																																																																																																
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900-02	5-7	1210	24	/	1																																																																																																																																																
900-03		1230	25	/	1																																																																																																																																																
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<p>Relinquished By:</p> <p>(1) Signature <u>Deborah J. Jarrett</u> Printed Name <u>Cerita Jarrett</u> Date <u>5/10/04</u> Time <u>10:00</u> Company <u>Kent & Sullivan</u></p> <p>Received By:</p> <p>(2) Signature <u>Derek J. Jarrett</u> Printed Name <u>Derek Jarrett</u> Date <u>5/11/04</u> Time <u>1645</u> Company <u>Kent & Sullivan</u></p>																																																																																																																																																					
<p>Relinquished By:</p> <p>(1) Signature _____ Printed Name _____ Date _____ Time _____ Company _____</p> <p>Received By:</p> <p>(2) Signature _____ Printed Name _____ Date _____ Time _____ Company _____</p>																																																																																																																																																					

Comments:

Comments: C Hold analysis pending metal
700-01, 700-02, 900-01, 05A-01

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Reinquished By:	<i>[Signature]</i>
Printed Name	George Warrick
Date	Sep-04
Time	10:00
Card No.	100-10000

*Solemnly Subscribed and Sealed
in the presence of*

(2) _____ Time _____

Received By:	<i>Frank</i>		
Signature	<i>Frank A. B. H.</i>		
Printed Name	<i>Frank A. B. H.</i>		
Date	<u>5/1/04</u>	Time	<u>1645</u>
Company	<i>Western Airlines</i>		
Received By:			
Signature			
Printed Name			
Date			
Time			
Company			

Paragon Analytics, Inc. -- Fort Collins, Colorado

CONDITION OF SAMPLE UPON RECEIPT FORM

CLIENT: Kent + Sullivan WORKORDER NO: 0405097
 PROJECT MANAGER: Debbie Fazio INITIALS: aw DATE: 5/12/04

1. Does this project require any special handling in addition to standard Paragon procedures?	<input checked="" type="checkbox"/> Yes	No	
IS PRE-SCREENING REQUIRED? (radiochemistry, DOE, etc.)		<input checked="" type="checkbox"/> Yes	No
2. Are custody seals on shipping containers intact? How many custody seals are provided? <u>2 each</u>	N/A	<input checked="" type="checkbox"/> Yes	No
3. Are the custody seals on sample containers intact?	(N/A)	Yes	No
4. Is there a Chain-of-Custody (COC) or other representative documents, letters, or shipping memos?		<input checked="" type="checkbox"/> Yes	No
5. Is the COC complete? Relinquished: Yes <input checked="" type="checkbox"/> No Analyses Requested: Yes <input checked="" type="checkbox"/> No	N/A	<input checked="" type="checkbox"/> Yes	No
6. Is the COC in agreement with the samples received? No. of Samples: Yes <input checked="" type="checkbox"/> No Sample ID's: Yes <input checked="" type="checkbox"/> No Matrix: Yes <input checked="" type="checkbox"/> No No. of Containers: Yes <input checked="" type="checkbox"/> No	N/A	<input checked="" type="checkbox"/> Yes	No
7. Were COC (if applicable) and sample labels legible?		<input checked="" type="checkbox"/> Yes	No
8. Were airbills present and/or removable?	N/A	<input checked="" type="checkbox"/> Yes	No
9. Are all aqueous samples requiring chemical preservation preserved correctly (excluding volatile organics)? Are all aqueous non-preserved samples at the correct pH?	(N/A)	Yes	No
10. Is there enough sample for requested analyses? If so, were samples placed in the proper containers?		<input checked="" type="checkbox"/> Yes	No
11. Are all samples within holding times for the requested analyses?		<input checked="" type="checkbox"/> Yes	No
12. Were all sample containers received intact? (not broken or leaking, etc.)		<input checked="" type="checkbox"/> Yes	No
13. Are samples requiring no headspace (volatiles, reactive cyanide/sulfide, radon), headspace free? Size of bubble: <u>< green pea</u> ; <u>> green pea</u> (List sample IDs and affected containers on Page 2)	(N/A)	Yes	No
14. Were samples checked for and free from the presence of residual chlorine?	(N/A)	Yes	No
15. Were the sample(s) shipped on ice?	N/A	<input checked="" type="checkbox"/> Yes	No
16. Were cooler temperatures measured at 0.1 - 6 °C ? IR Gun Used*: <u>D 2</u>	N/A	Yes	<input checked="" type="checkbox"/> No
17. Were all samples cooled that should have been cooled?	N/A	Yes	<input checked="" type="checkbox"/> No

Cooler #'s 924 898 897 749 808 22
 Temperature 10° 10° 9° 15° 12° 14° °C

Project Manager Signature / Date: Debbie Fazio 5/12/04

A NO RESPONSE TO ANY QUESTION EXCEPT # 1 REQUIRES THE COMPLETION OF PAGE 2 OF THIS FORM

- * IR Gun #1 (original): Raytek, SN SC-PM3/T29403
- IR Gun #2 (newer): Oakton, SN 2SCIR1201

Paragon Analytics, Inc. -- Fort Collins, Colorado
CONDITION OF SAMPLE UPON RECEIPT FORM

CLIENT: Kent + Sullivan WORKORDER NO: 0405097
 PROJECT MANAGER: Debbie Fazio INITIALS: dw DATE: 5/12/04

- Custody seals broken (on outside of shipping container or on sample containers).
- No Chain-of-Custody (COC) present.
- Number of samples on the COC do not match the number of samples received.
- Aqueous samples not preserved correctly (see pH discussion below).
- SVOC samples contained residual chlorine (list sample IDs and affected containers below).
- Samples received at inappropriate temperature.
- Insufficient sample to perform requested analyses.
- Extraction or analytical holding times expired in transit.
- Broken/leaking bottles and intact bottles received in same cooler (list affected sample IDs below).
- No analyses requested.
- Incorrect sample type received.
- VOAs, reactive CN/S, radon not headspace free (list sample IDs and affected vials below).
- Airbills not present and/or removable (record applicable shipper's tracking number below).
- Other (describe below).

Describe discrepancy:

All samples received between 9° - 15° C. Refer to page 1 for cooler temperatures and refer to DOT Survey pages for cooler contents. Insufficient ice packed with samples.

Was the client contacted? No; Yes: Name Sue Kent Date/Time 5/12/04

Was the pH of any sample adjusted by the laboratory? No; Yes (see Table below):

NOTE: No pH adjustments shall be made without prior consent of Project Manager. After pH adjustment, hold metals and radchem samples ≥ 16 hr before analysis.

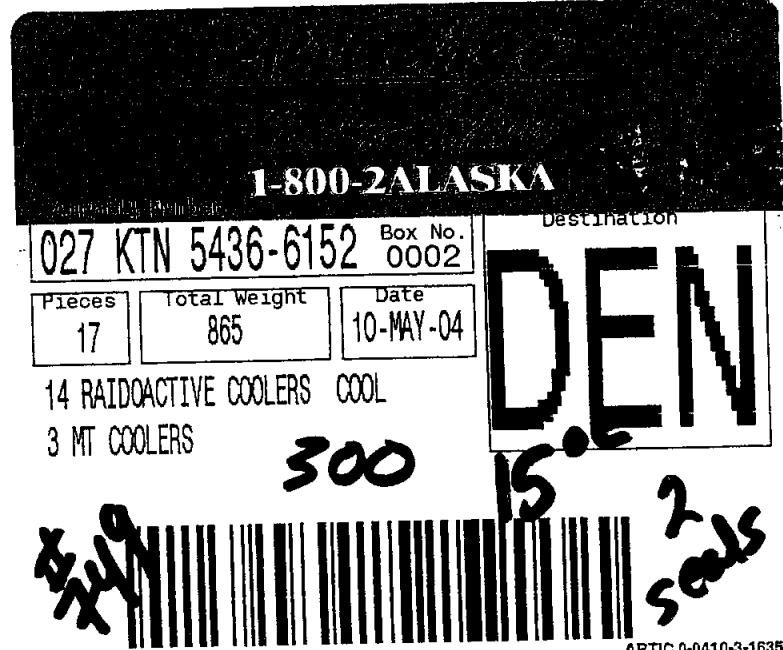
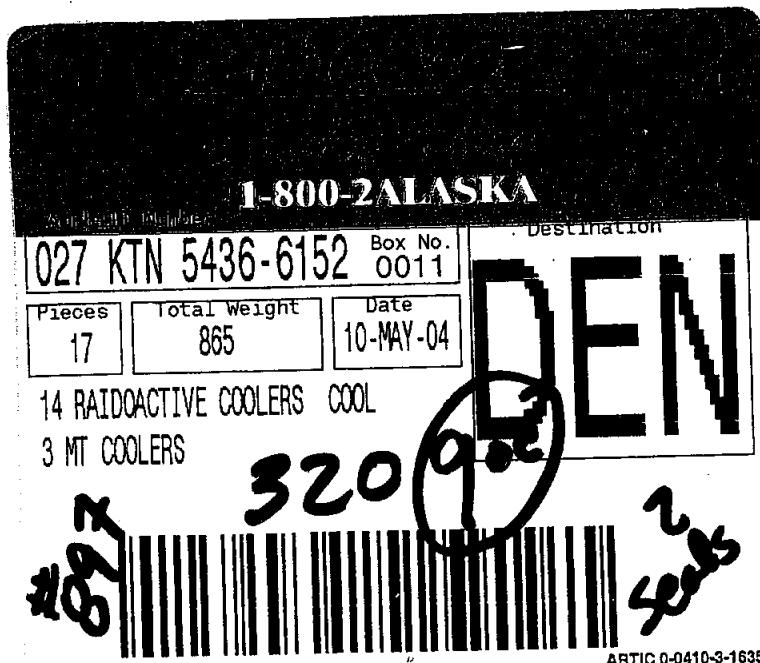
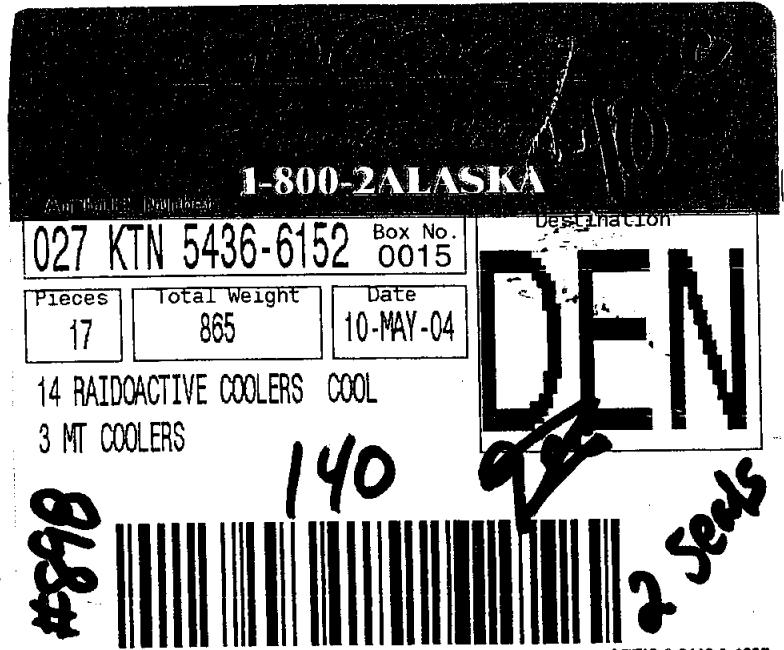
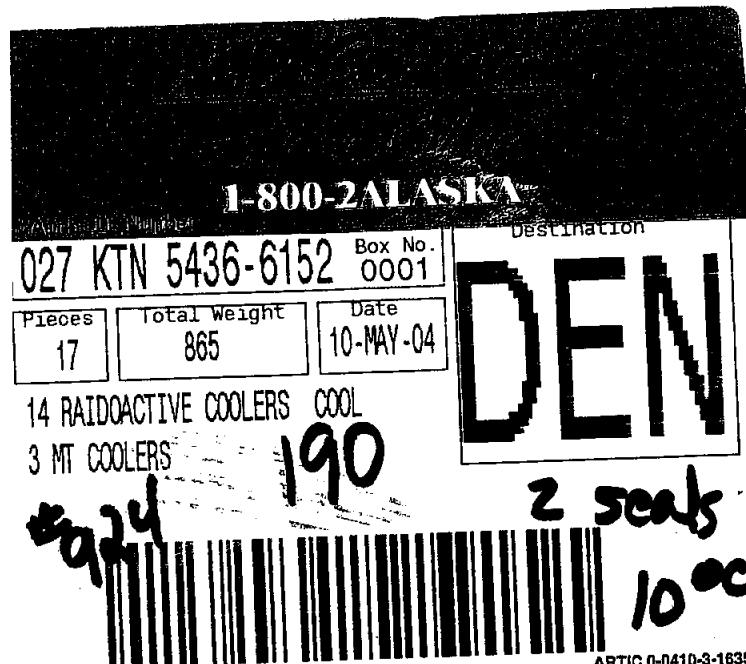
Sample ID	Initial pH	Final pH (wait 30 min)	Type of Reagent Used	Lot No. of Reagent Used	Initials / Date / Time

Was the laboratory directed to proceed with the analysis of any samples yielding the presence of residual chlorine? No; Yes (see notes above).

Project Manager Signature / Date: PJ 5/12/04

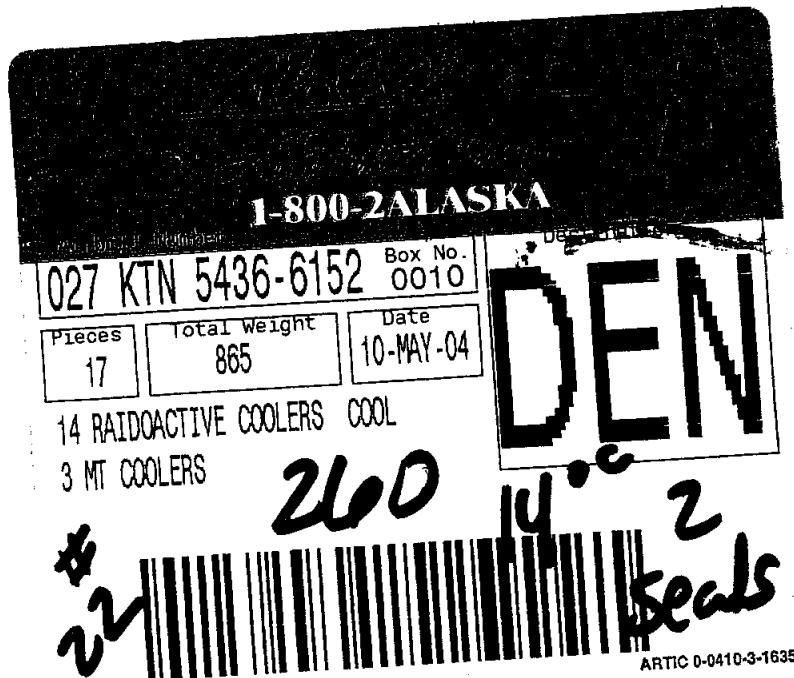
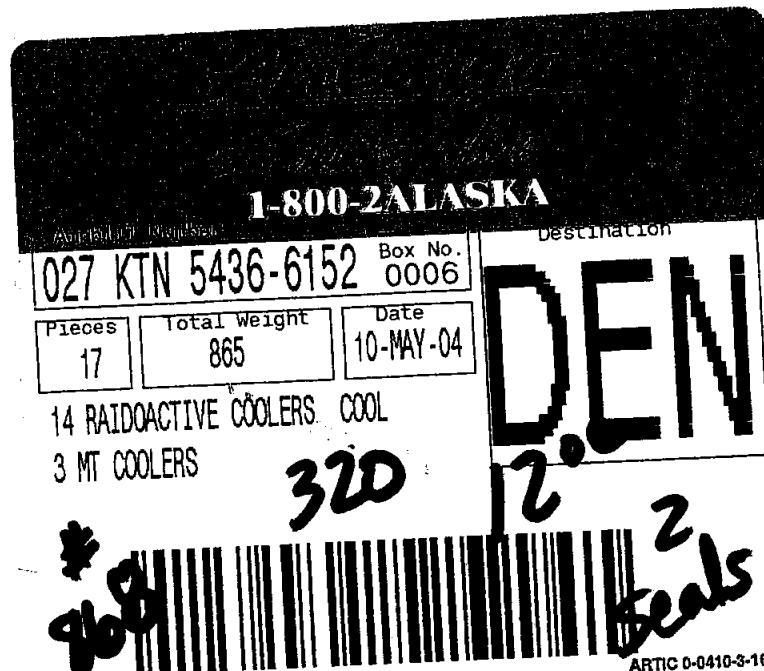
000090
Page 2 of 2

0405096
0405097



000091

0405096
0405097



000092

SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AWDate: 05/12/04COOLER #: 924External Micro R Meter Reading (μ R/hr): 190**Paragon Sample ID:**

0405096-1-1
 0405096-1-2
 0405096-2-1
 0405096-2-2
 0405096-2-3
 0405096-3-1
 0405096-3-2
 0405096-3-3
 0405096-7-1
 0405096-7-2
 0405096-7-3
 0405096-8-1
 0405096-8-2
 0405096-8-3
 0405096-9-1
 0405096-9-2
 0405096-9-3
 0405096-10-1
 0405096-10-2
 0405096-10-3
 0405096-16-1
 0405096-16-2
 0405096-16-3

Client Sample ID:

MSED-01
 MSED-01
 MSED-02
 MSED-02
 MSED-02
 MSED-03
 MSED-03
 MSED-03
 MSED-07
 MSED-07
 MSED-07
 MSED-08
 MSED-08
 MSED-08
 MSED-09
 MSED-09
 MSED-09
 MSED-10
 MSED-10
 MSED-10
 SSED-06
 SSED-06
 SSED-06

Micro R Meter Reading (μ R/hr):

< background
 35
 75
 < background
 30
 < background
 < background
 150
 > background
 30
 40
 < background
 < background
 < background
 70
 60
 80
 85
 85
 85
 800

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: _____ Date/Time: _____

Project Manager Signature/ Date: _____

000093

SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AW Date: 05/12/04COOLER #: 898External Micro R Meter Reading (μ R/hr): 140

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-4-1	MSED-04	< background
0405096-4-2	MSED-04	< background
0405096-4-3	MSED-04	< background
0405096-11-1	SSED-01	< background
0405096-11-2	SSED-01	< background
0405096-11-3	SSED-01	< background
0405096-26-1	SOIL-02	< background
0405096-26-2	SOIL-02	< background
0405096-26-3	SOIL-02	< background
0405096-27-1	SOIL-04	< background
0405096-27-2	SOIL-04	40
0405096-27-3	SOIL-04	< background
0405096-28-1	SOIL-05	30
0405096-28-2	SOIL-05	< background
0405096-28-3	SOIL-05	< background
0405097-4-1	GR-01	< background
0405097-6-1	GR-03	< background
0405097-13-1	GR-10	< background
0405097-14-1	QM-01	< background
0405097-16-1	QM-03	< background
0405097-18-1	300-02	45
0405097-19-1	700-01	1000
0405097-19-2	700-01	950
0405097-19-3	700-01	1100

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: _____ Date/Time: _____

Project Manager Signature/ Date: _____

SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AW Date: 05/12/04COOLER #: 897External Micro R Meter Reading (μ R/hr): 320

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-5-1	MSED-05	< background
0405096-5-2	MSED-05	< background
0405096-5-3	MSED-05	< background
0405096-21-1	GEN-01	28
0405096-21-2	GEN-01	28
0405096-22-1	GEN-02	30
0405096-22-2	GEN-02	29
0405096-22-3	GEN-02	< background
0405096-22-4	GEN-02	< background
0405096-22-5	GEN-02	< background
0405096-23-1	GEN-03	< background
0405096-23-2	GEN-03	< background
0405096-24-1	GEN-04	< background
0405096-24-2	GEN-04	< background
0405097-9-1	GR-06	30
0405097-11-1	GR-08	< background
0405097-15-1	QM-02	< background
0405097-20-1	700-02	250
0405097-24-1	900-02	1500
0405097-25-1	900-03	300
0405097-27-1	900-05	100

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: _____ Date/Time: _____

Project Manager Signature/ Date: _____

SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AWDate: 05/12/04COOLER #: 749External Micro R Meter Reading (μ R/hr): 300

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-6-1	MSED-06	40
0405096-12-1	SSED-02	40
0405096-12-2	SSED-02	< background
0405096-12-3	SSED-02	< background
0405096-18-1	SSED-08	< background
0405096-18-2	SSED-08	< background
0405096-18-3	SSED-08	30
0405096-19-1	SSED-09	< background
0405096-19-2	SSED-09	< background
0405096-19-3	SSED-09	< background
0405096-25-1	SOIL-01	< background
0405096-25-2	SOIL-01	< background
0405096-25-3	SOIL-01	< background
0405097-1-1	HR-01	140
0405097-5-1	GR-02	< background
0405097-7-1	GR-04	90
0405097-28-1	OSA-01	1200
0405097-28-2	OSA-01	1100
0405097-28-3	OSA-01	1200

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: _____ Date/Time: _____

Project Manager Signature/ Date: _____

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SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AW Date: 05/12/04COOLER #: 868External Micro R Meter Reading (μ R/hr): 320

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-13-1	SSED-03	< background
0405096-13-2	SSED-03	< background
0405096-13-3	SSED-03	< background
0405096-14-1	SSED-04	< background
0405096-14-2	SSED-04	< background
0405096-14-3	SSED-04	< background
0405096-15-1	SSED-05	< background
0405096-15-2	SSED-05	< background
0405096-15-3	SSED-05	< background
0405096-17-1	SSED-07	< background
0405096-17-2	SSED-07	< background
0405096-17-3	SSED-07	< background
0405096-20-1	SSED-10	< background
0405096-20-2	SSED-10	< background
0405096-20-3	SSED-10	< background
0405097-8-1	GR-05	< background
0405097-10-1	GR-07	< background
0405097-12-1	GR-09	< background
0405097-21-1	700-03	800
0405097-21-2	700-03	950
0405097-21-3	700-03	850
0405097-26-1	900-04	95
0405097-29-1	OSA-02	180
0405097-29-2	OSA-02	150
0405097-29-3	OSA-02	160
0405097-30-1	OSA-03	200
0405097-30-2	OSA-03	250
0405097-30-3	OSA-03	150

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: _____ Date/Time: _____

Project Manager Signature/ Date: _____

000097
PAGE 5 OF 6

SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AW Date: 05/12/04COOLER #: 22External Micro R Meter Reading (μ R/hr): 260

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-29-1	SOIL-07	< background
0405096-29-2	SOIL-07	< background
0405096-29-3	SOIL-07	< background
0405096-30-1	SOIL-08	45
0405096-30-2	SOIL-08	40
0405096-30-3	SOIL-08	40
0405096-31-1	SOIL-09	< background
0405096-31-2	SOIL-09	< background
0405096-31-3	SOIL-09	< background
0405096-32-1	SOIL-10	55
0405096-32-2	SOIL-10	50
0405096-32-3	SOIL-10	65
0405097-22-1	700-04	450
0405097-23-1	900-01	110
0405097-23-2	900-01	110
0405097-23-3	900-01	140

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: _____ Date/Time: _____

Project Manager Signature/ Date: _____

PARAGON ANALYTICS
Radiochemistry Data Package

Section 9

**ADDITIONAL
SUPPORTING
DOCUMENTATION**

9

000099

Efficiency Calibrations

**^{226}Ra by Rn Emanation
Calibration Package
for
Detectors A and B**

af

²²⁶Ra by Rn Emanation Calibration Package Order Checklist
Rev. 09/22/03 AF (THIS SHEET FOR REFERENCE PURPOSES ONLY- NOT A CONTROLLED DOCUMENT)

- TITLE PAGE
- VOLTAGE
- PLATEAU PLOTS
- QASS's
- LOGBOOK PAGES
- EFFICIENCY
- QASS's
- CALIBRATION RESULTS SHEET (A)
- CALIBRATION SUMMARY SHEET (A)
- BENCHSHEETS (A)
- CALIBRATION RESULTS SHEET (B)
- CALIBRATION SUMMARY SHEET (B)
- BENCHSHEETS (B)
- LOGBOOK PAGES
- CALIBRATION SPIKE VERIFICATION PACKAGE
- DAILY CHECKS
- DAILY CHECK SUMMARY PAGES → LOGBOOK PAGES
- DAILY CHECK CERTIFICATE
- ICV's
- RADIOMETRIC RECOVERY SUMMARY PAGE
- QASS's
- BENCHSHEETS
- LOGBOOK PAGES
- DAILY CHECK SUMMARY PAGES
- SPIKE VERIFICATION PACKAGE

²²⁶Ra by Rn Emanation Calibration Package Review Checklist
Rev. 09/22/03 AF (THIS SHEET FOR REFERENCE PURPOSES ONLY- NOT A CONTROLLED DOCUMENT)

Is all appropriate documentation included?

- Any necessary QASS sheets
- ICV benchesheets and verification sheet
- Lucas Cell + PMT Calibration Control Summaries
- Printed and handwritten benchesheets for all detectors calibrated
- Log book page copies for all calibration dates
- Daily check sheets
- PMT Operating Voltage handwritten and printed benchesheets and plateau curve
- Reagent prep log book pages for all standardized reagents used
- Standard prep log book pages for all standards used
- NIST Certificates for all standards used
- Verification information for all standards used

Is all documentation filled out properly?

- Current SOPs documented
- All benchesheets properly dated and initialed
- Handwritten benchesheets match printed benchesheets
- Log book sheets match handwritten benchesheets
- Efficiencies from Calibration Results page match Lucas Cell + PMT Calibration Control Summary, ISV calculation page, and detector calculation page

Quality Control

- ICV radiometric recovery is in control at 80-120%
- Cell backgrounds are less than 100 cts. per 30 min.
- There is at least a 4 hr. ingrowth period between deemanation and count start
- Efficiencies are within control
- Daily check gross counts are in control

²²⁶Ra by Rn Emanation Calibration Package Order Checklist
Rev. 09/22/03 AF (THIS SHEET FOR REFERENCE PURPOSES ONLY- NOT A CONTROLLED DOCUMENT)

- TITLE PAGE
- VOLTAGE
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 - CALIBRATION RESULTS SHEET (A)
 - CALIBRATION SUMMARY SHEET (A)
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 - CALIBRATION RESULTS SHEET (B)
 - CALIBRATION SUMMARY SHEET (B)
 - BENCHSHEETS (B)
 - LOGBOOK PAGES
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- DAILY CHECKS
 - DAILY CHECK SUMMARY PAGES
 - DAILY CHECK CERTIFICATE

LOGBOOK PAGES
- ICV's
 - RADIOMETRIC RECOVERY SUMMARY PAGE
 - QASS's
 - BENCHSHEETS
 - LOGBOOK PAGES
 - DAILY CHECK SUMMARY PAGES
 - SPIKE VERIFICATION PACKAGE

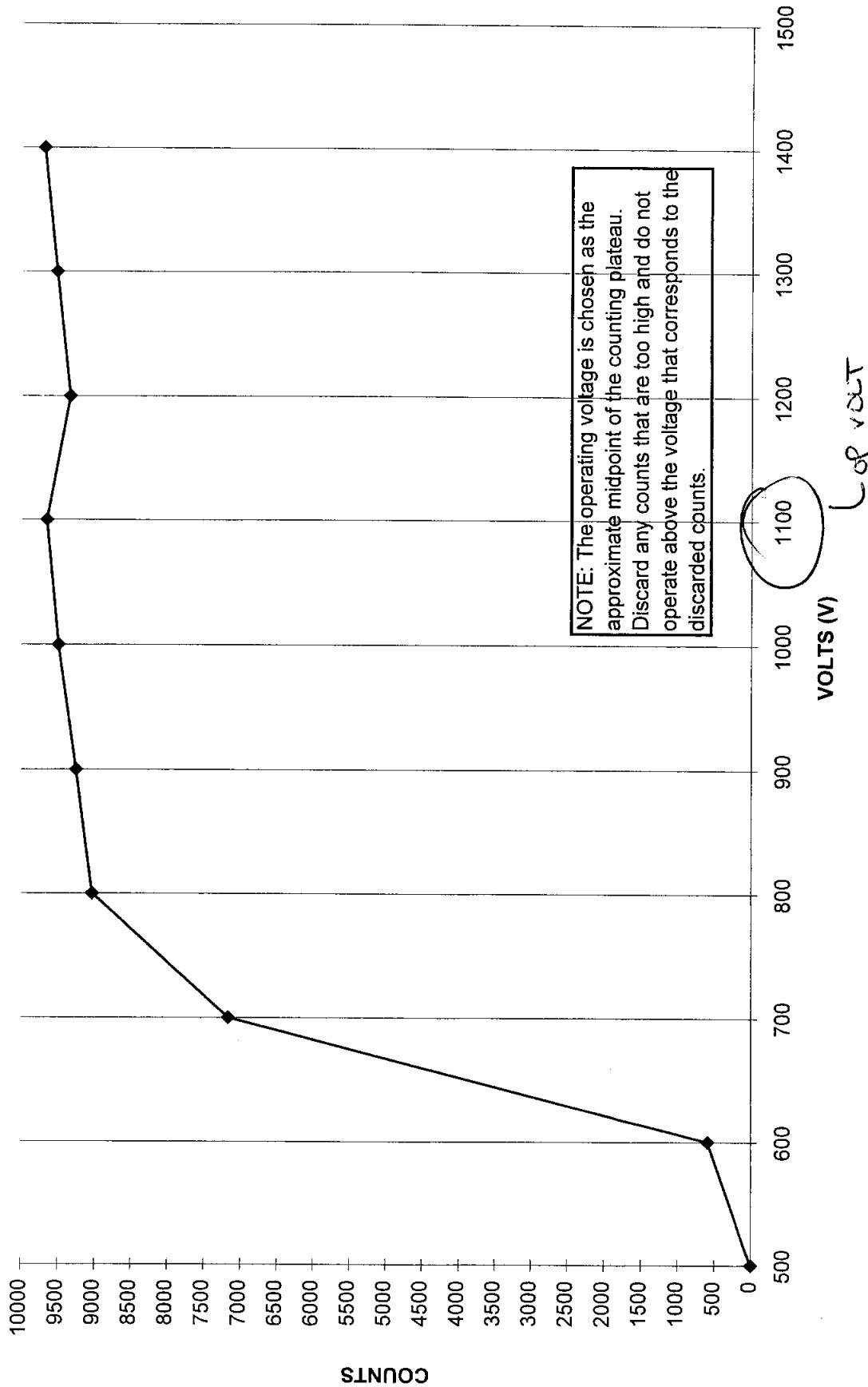
Voltage Plateau Data

COUNTS

PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE			
²³⁰ Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES			
DATE:	6/21/04	ANALYST:	AF <i>af</i>
DETECTOR/SCALAR:	1A		
VOLTS	COUNTS		
500	0		
600	589		
700	7164		
800	9035		
900	9249		
1000	9498		
1100	9657	— OF VOLT	
1200	9340		
1300	9526		
1400	9695		
1500	21426		
REVIEWED BY:			

PLATEAU

OPERATING VOLTAGE FOR DETECTOR/SCALAR 1A



COUNTS

PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

²³⁰Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES

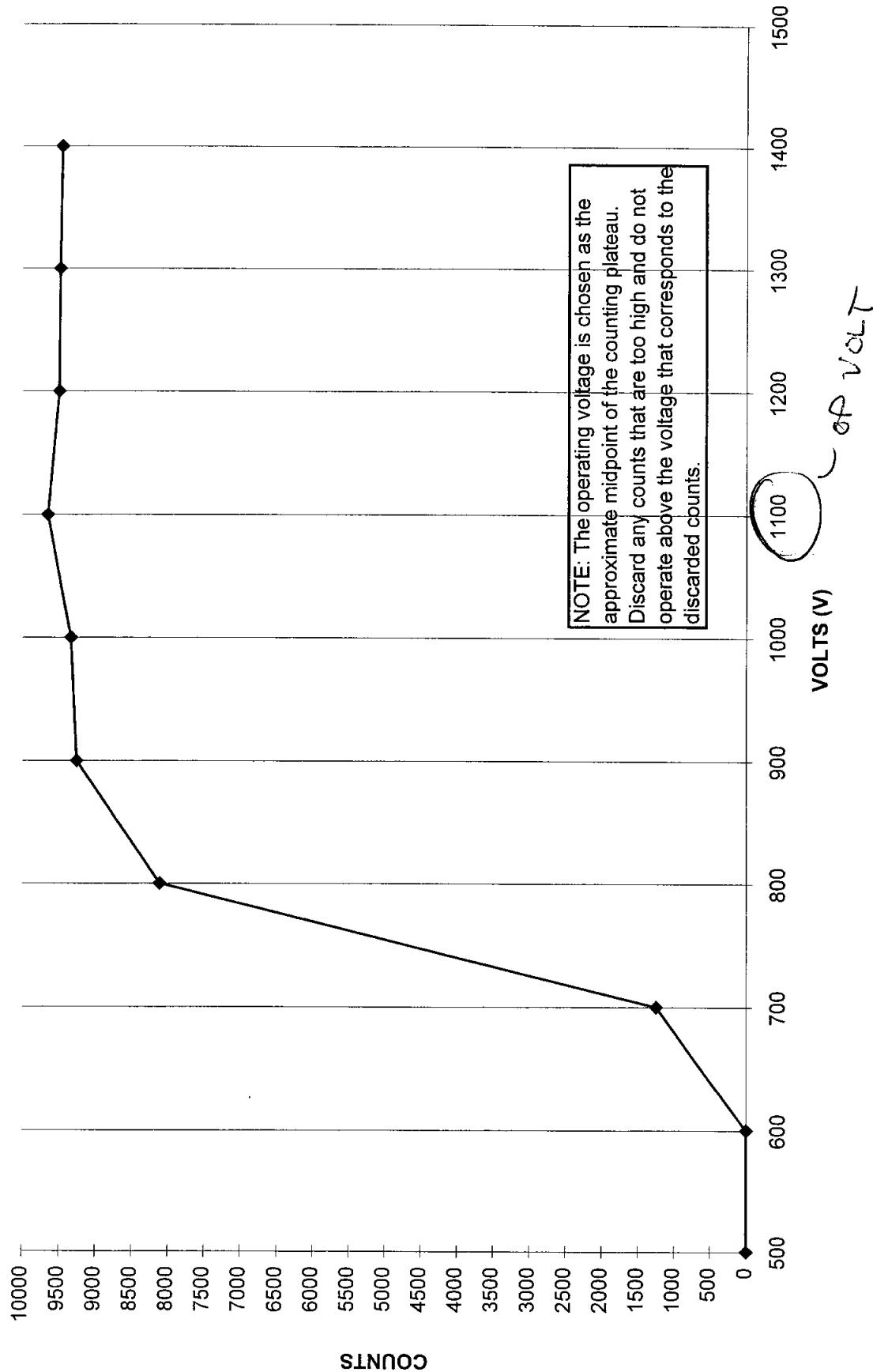
DATE: 6/21/04 ANALYST: AF *AS*
DETECTOR/SCALAR: 2B

VOLTS	COUNTS
500	0
600	0
700	1241
800	8109
900	9254
1000	9336
1100	9652
1200	9497
1300	9485
1400	9457
1500	13965

REVIEWED BY:

PLATEAU

OPERATING VOLTAGE FOR DETECTOR/SCALAR 2B



Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH 271033 TEST CALIBRATION
METHOD 226Ra
SOP/REV (PREP) 903.1
SOP/REV (ANAL) 783R5

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

Q 02/03/04

THE OPERATING VOLTAGE FOR SCALAR/DETECTOR COMBINATIONS
WAS DETERMINED AS FOLLOWS:

1. ADJUST THE VOLTAGE OF THE SCALAR TO A LOW VOLTAGE (500V).
2. COUNT THE 18,000 dpm ^{230}Th SOURCE FOR 1 MINUTE AND RECORD THE COUNTS IN THE EMANATION MAINTENANCE LOG.
3. ADJUST THE VOLTAGE OF THE SCALAR BY 100V AND REPEAT STEP 2.
4. CONTINUE THIS PROCESS UNTIL THE GROSS COUNTS ARE CLEARLY OUT OF RANGE (>10,000, USUALLY ABOUT 1500V).
5. PLOT THE VOLTAGE AGAINST THE GROSS COUNTS ON A SCATTER PLOT.
6. REPEAT THE PROCESS DESCRIBED IN STEP 2 WITH NOTHING IN THE DETECTOR FOR OPERATING VOLTAGES ON THE PLATEAU TO DETERMINE DETECTOR BACKGROUND AT DIFFERENT OPERATING VOLTAGES. RECORD THE COUNTS IN THE EMANATION MAINTENANCE LOG.
7. CHOOSE AN OPERATING VOLTAGE ON THE PLATEAU THAT GIVES THE LOWEST POSSIBLE BACKGROUND COUNTS (PREFERABLY 0).

Q 02/03/04

Q 02/03/04

TECHNICIAN/ANALYST

DATE 02/03/04

DEPARTMENT MANAGER

DATE 2/13/04

VOLTAGE PLATEAUS FOR COUNTERS 1A & 2B.
Th-Source counted for 1 min. at each voltage.

<u>VOLT. (KV)</u>	<u>1A</u>	<u>2B</u>
0.5	Ø	Ø
0.6	589	Ø
0.7	7164	1241
0.8	9035	8109
0.9	9249	9254
1.0	9498	9336
1.1	9657	9652
1.2	9340	9497
1.3	9526	9485
1.4	9695	9457
1.5	21426	13965

BACKGROUND COUNTS (NO SOURCE COUNTED) AT PLATEAU ENERGIES
FOR COUNTERS 1A & 2B, 1min COUNTS

<u>VOLT(KV)</u>	<u>1A</u>					<u>2B</u>				
	1	2	3	4	5	1	2	3	4	5
0.9	Ø	Ø	30	Ø	Ø	Ø	Ø	Ø	Ø	Ø
1.0	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
1.1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
1.2	3	2	4	1	2	Ø	Ø	Ø	Ø	Ø
1.3	15	14	13	11	15	5	6	4	6	4

Continued on Page

Read and Understood By

Signed

6/19/04

Date

Signed

Date

• 000110

Efficiency Data

000111

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

271011

PAI W.O. # / BATCH CALIBRATION
TEST ²²⁶Ra
METHOD 903.1
SOP/REV (PREP) 783R5
SOP/REV (ANAL)

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

G 01/19/04

CALIBRATION SOURCES WERE PREPARED IN THE FOLLOWING MANNER:

1. 23 mL OF EDTA WAS ADDED TO EACH VOA VIAL.
2. EACH VIAL WAS SPIKED WITH 2 mL OF THE CALIBRATION SOURCE (460.1572.47)
3. THE VIALS WERE PURGED WITH He AND ALLOWED TO INGROW FOR AT LEAST 7 DAYS.

G 01/19/04

G 01/19/04

INDEPENDENT CALIBRATION VERIFICATION (ICV) SOURCES WERE PREPARED IN THE MANNER STATED ABOVE, USING THE ²²⁶Ra SPIKING SOURCE TO SPIKE THE VIALS.

G c11/19/04

TECHNICIAN/ANALYST

DEPARTMENT MANAGER

DATE 01/19/04

DATE 1/19/04

QUALITY ASSURANCE SUMMARY SHEET

268304

PAI W.O. # / BATCH CALIBRATION
 TEST ²²⁶Re
 METHOD 903.1
 SOP/REV (PREP) 783R5
 SOP/REV (ANAL) —

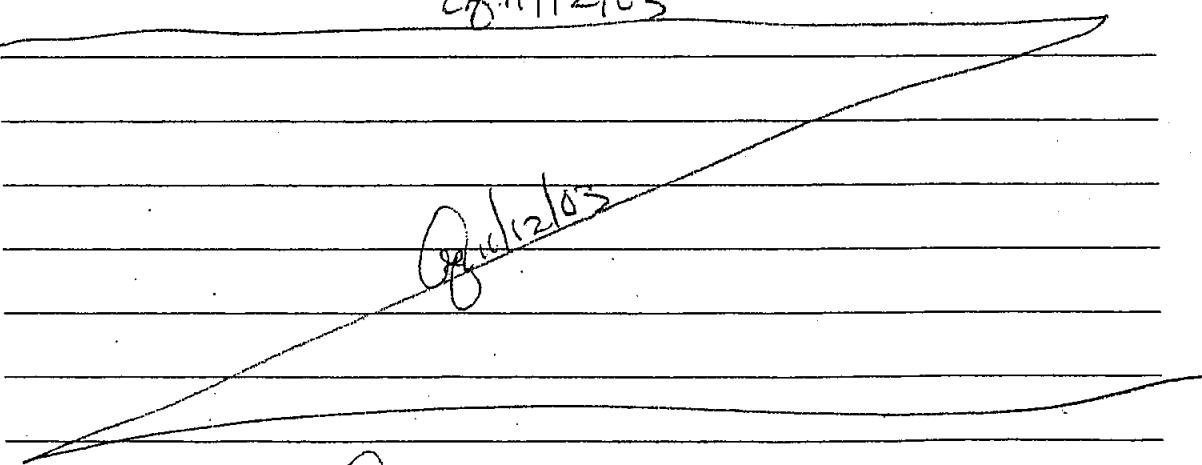
Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

8/11/03

BACKGROUND COUNTS FOR SOME CELL-DETECTOR COMBINATIONS WERE COUNTED FOR LESS THAN THE SAMPLE COUNT TIME AND EXTRAPOLATED TO THE LONGER COUNT TIME (SEE CALCULATION BELOW). SINCE >10000 COUNTS ARE OBTAINED FOR EACH SAMPLE, THE ERROR ASSOCIATED WITH CORRECTING THE BACKGROUND COUNTS TO THE SAMPLE COUNT TIME IS NOT SIGNIFICANT. THE CORRECTED DATA IS THEREFORE SUBMITTED WITHOUT QUALIFICATION. 8/12/03 8/12/03

BACKGROUND COUNT CORRECTION:

$$\frac{\text{BKG COUNTS}}{\text{BKG COUNT TIME}} = \frac{\text{CORRECTED BKG}}{\text{SAMPLE COUNT TIME}}$$

8/11/12/03

TECHNICIAN/ANALYST

DEPARTMENT MANAGER

DATE 8/11/03DATE 8/12/03

Calibration Results

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Calibration results													
Analyst:	AF	Prep. Date S:	6/10/04	Count Date:	6/22/04-6/24/04								
Prep. Date C:	6/10/04	SOP Used:	783R5										
		S	Flask	Counter	Scaler	Ra-226							
W.O.#	ID	No.	No.	No.	No.	Standard (dpm)	Efficiency						
418009	S1	1	1	A	A	239	2.2384						
418009	S2	2	1	A	A	239	2.6756						
418009	S3	3	1	A	A	239	2.6358						
418009	S4	4	1	A	A	239	2.5025						
418009	S5	6	1	A	A	239	2.5248						
418009	S7	8	1	A	A	239	2.1225						
418009	S14	9	1	A	A	239	2.5149						
418009	S9	10	1	A	A	239	2.1198						
418009	S10	12	1	A	A	239	2.2961						
418009	S11	13	1	A	A	239	2.2478						
418009	S12	14	1	A	A	239	2.4569						

000114

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: AF
 Prep. Date S: 6/10/04
 Prep. Date C: 6/10/04
 SOP Used: 783R5

W.O.#	ID	S	V	Burnt (end)	Time	Flask	Counter	Scaler	CBKG	CBKG	Date	Time	Count Start			Remarks
													D2	T2	D3	
04-18-009	S1	1	6/10/04	11:15	1	1	A	18	30	6/21/04	11:24	6/24/04	15:44	25	11215	
04-18-009	S2	1	6/10/04	11:15	2	1	A	17	23	6/21/04	11:24	6/21/04	16:13	20	10678	
04-18-009	S3	1	6/10/04	11:15	3	1	A	19	25	6/21/04	12:13	6/21/04	17:15	20	10515	
04-18-009	S4	1	6/10/04	11:15	4	1	A	22	37	6/21/04	12:13	6/21/04	18:01	25	12410	
04-18-009	S5	1	6/10/04	11:15	6	1	A	17	23	6/22/04	10:46	6/22/04	14:50	20	10392	
04-18-009	S7	1	6/10/04	11:15	8	1	A	14	23	6/22/04	11:47	6/22/04	17:24	25	10800	
04-18-009	S9	1	6/10/04	11:15	10	1	A	22	37	6/23/04	10:00	6/23/04	16:10	25	10966	
04-18-009	S10	1	6/10/04	11:15	12	1	A	21	35	6/23/04	10:00	6/23/04	17:15	25	11777	
04-18-009	S11	1	6/10/04	11:15	13	1	A	25	42	6/23/04	12:27	6/23/04	17:53	25	11718	
04-18-009	S12	1	6/10/04	11:15	14	1	A	23	38	6/23/04	12:27	6/23/04	18:38	25	12729	
04-18-009	S14	1	6/10/04	11:15	9	1	A	42	56	6/24/04	9:29	6/24/04	14:24	20	10711	

SEE QASS#

Std./ Ba Carrier Id	'Std./ Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47	Ra 226	2.0	RS011

Spiked by: AF 6/10/04
 Spike Witness: NT 6/10/04
 Reviewed by: *[Signature]*

000116

6/25/04.....11:02 PM

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: AF

Prep. Date S: 6/10/04

Prep. Date C:

SOP Used: 783R5

W.O.#	ID	S	V	Date	Time	Flask	Counter	Scaler	CBKG	(CORR.)	CBKG	Date	Time	Count start	Count	Duration	Count	Duration	Remarks		
04-18-009	S1	1	1	6/10/04	11:15	1	1	A	18	0	6/12/04	11:24	6/12/04	15:11	25	11215					
04-18-009	S2	1	2	1		2	1	A	17	0				16:13	20	10878	P&D O				
04-18-009	S3	1	3	1		3	1	A	19	0				17:15	20	10515					
04-18-009	S4	1	4	1		4	1	A	22	0				18:01	25	12410					
04-18-009	S5	1	6	1		6	1	A	17	0	6/12/04	10:46	6/12/04	14:30	20	10392					
04-18-009	S6	1	7	1		7	1	A	10	0				15:37	25	11929					
04-18-009	S7	1	8	1		8	1	A	14	0				17:24	25	10800					
04-18-009	S8	1	9	1		9	1	A	23	0				18:01	20	10863	P&D O				
04-18-009	S9	1	10	1		10	1	A	22	0	6/12/04	10:00	6/12/04	16:10	25	10964	P&D O				
04-18-009	S10	1	12	1		12	1	A	21	0				17:15	25	11777					
04-18-009	S11	1	13	1		13	1	A	25	0				17:33	25	11718					
04-18-009	S12	1	14	1		14	1	A	23	0				18:38	25	12725					
04-18-009	S13	1	2	1		2	1	A	49	0	6/12/04	09:29	6/12/04	13:49	20	11272					
04-18-009	S14	1	9	1		9	1	A	42	0				14:24	26	16711					
04-18-009	S15	1	10	1		10	1	A	57	0				15:21	25	11801					
04-18-009	S16	1				1	A		0												
04-18-009	S17	1				1	A		0												
04-18-009	S18	1				1	A		0												
04-18-009	S19	1				1	A		0												
04-18-009	S20	1				1	A		0												
04-18-009	S21	1				1	A		0												
04-18-009	S22	1				1	A		0												
04-18-009	S23	1				1	A		0												
04-18-009	S24	1				1	A		0												
04-18-009	S25	1				1	A		0												
04-18-009	S26	1				1	A		0												
04-18-009	S27	1				1	A		0												
04-18-009	S28	1				1	A		0												
04-18-009	S29	1				1	A		0												
04-18-009	S30	1				1	A		0												

SEE QASS#

Std./Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47 Ra 226	2.0	E511

Spiked by: Bob Gellman
 Spike Witness: JT Q10101
 Reviewed by: _____

6/10/04.....10:35 AM

000117

Calibration Results

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1									
Calibration results									
W.O.#	ID	Flask No.	Counter No.	Scaler No.	Ra-226 Standard (dpm)	Efficiency			
418009	S1	1	2	B	239	2.056			
418009	S2	2	2	B	239	2.6656			
418009	S3	3	2	B	239	2.4695			
418009	S4	4	2	B	239	2.4692			
418009	S5	6	2	B	239	2.3713			
418009	S7	8	2	B	239	2.0138			
418009	S14	9	2	B	239	2.4211			
418009	S9	10	2	B	239	2.0996			
418009	S10	12	2	B	239	2.2417			
418009	S11	13	2	B	239	2.1379			
418009	S12	14	2	B	239	2.3670			

000118

Lucas Cell + PMT Calibration Control Summary

r:\ims\ralphscrt\cell.xls
•Control limits established 01/14/04-01/21/04

Reviewed By _____ Date _____

6

000119

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: AF
 Prep. Date S: 6/10/04
 Prep. Date C: 6/10/04
 SOP Used: 783RS

W.O.#	ID	(L)	S	V	Purge (end)	Time	Flask	Counter No.	Scaler No.	CBKG #	CBKG (CORR.) *	Deceman. (end)	Date	Time	Count Start Date	Time	Duration	Count	REMARKS
04-18-009	S1	1	6/10/04	11:15	1	2	B	19	32	6/21/04	11:24	6/21/04	16:13	25	10464				
04-18-009	S2	1	6/10/04	11:15	2	2	B	8	11	6/21/04	11:24	6/21/04	15:44	20	10665				
04-18-009	S3	1	6/10/04	11:15	3	2	B	8	13	6/21/04	12:13	6/21/04	18:01	25	12322				
04-18-009	S4	1	6/10/04	11:15	4	2	B	5	12	6/21/04	12:13	6/21/04	17:15	35	17192				
04-18-009	S5	1	6/10/04	11:15	6	2	B	11	18	6/22/04	10:46	6/22/04	15:37	25	12116				
04-18-009	S7	1	6/10/04	11:15	8	2	B	12	20	6/22/04	11:47	6/22/04	18:01	25	10197				
04-18-009	S9	1	6/10/04	11:15	10	2	B	15	25	6/23/04	10:00	6/23/04	17:15	25	10762				
04-18-009	S10	1	6/10/04	11:15	12	2	B	9	15	6/23/04	10:00	6/23/04	16:10	25	11573				
04-18-009	S11	1	6/10/04	11:15	13	2	B	11	18	6/23/04	12:27	6/23/04	18:38	25	11061				
04-18-009	S12	1	6/10/04	11:15	14	2	B	13	22	6/23/04	12:27	6/23/04	17:53	25	12473				
04-18-009	S14	1	6/10/04	11:15	9	2	B	34	45	6/24/04	9:29	6/24/04	13:49	20	10310				

SEE QASS#

Std./Ba Carrier ID	Type	Spike Vol. (ml)	pipet No.
460-1572-47	Ra 226	2.0	RS011

Spiked by: AF 6/10/04
 Spike Witness: NT 6/10/04
 Reviewed by: AF 6/10/04

000120

6/25/04.....1:03 PM

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: AF

Prep. Date S: 6/10/04

Prep. Date C:

SOP Used: 783RS

W.O.#	ID	S	V	Date	Time	Flask	Counter	Scaler	CBNG	CBNG (CORR.)	Deceman. (end)			Count Start	Time	Date	Duration	Count	REMARKS	
											No.	No.	#	D2	T2	D3	T3	(min.)	#	
04-18-009	S1	1	6/10/04	11:15		1	2	B	10	0	102104	11:24	102104	10:13	25	10464				
04-18-009	S2	1				2	2	B	8	0			✓		15:44	20	10665	REDO		
04-18-009	S3	1				3	2	B	8	0			↓		18:04	25	12322			
04-18-009	S4	1				4	2	B	5	0			↓		17:15	35	17192			
04-18-009	S5	1				5	2	B	11	0	102204	10:46	102204	15:37	25	12116				
04-18-009	S6	1				6	2	B	8	0			↓		14:30	25	10784			
04-18-009	S7	1				7	2	B	8	0			↓		18:01	25	10977			
04-18-009	S8	1				8	2	B	12	0			↓		17:24	20	18308	REDO		
04-18-009	S9	1				9	2	B	7	0			↓							
04-18-009	S10	1				10	2	B	15	0	02304	10:00	02304	17:15	25	10762	REDO			
04-18-009	S11	1				11	2	B	9	0			↓		16:10	25	11573			
04-18-009	S12	1				12	2	B	13	0			↓		18:38	25	12779	11061 Q	6/23/04	
04-18-009	S13	1				13	2	B	16	0			↓		16:27	25	11027			
04-18-009	S14	1				14	2	B	13	0			↓		17:53	25	12473			
04-18-009	S15	1				15	2	B	15	0	02304	09:25	02404	14:22	20	10764				
04-18-009	S16	1				16	2	B	9	0			↓		16:10	25	11573			
04-18-009	S17	1				17	2	B	12	0			↓		18:38	25	12779	11061 Q	6/23/04	
04-18-009	S18	1				18	2	B	13	0			↓		16:27	25	11027			
04-18-009	S19	1				19	2	B	13	0			↓							
04-18-009	S20	1				20	2	B	12	0	02404	09:25	02404	14:22	20	10764				
04-18-009	S21	1				21	2	B	34	0			↓		16:10	25	11573			
04-18-009	S22	1				22	2	B	34	0			↓		18:38	25	12779	11061 Q	6/23/04	
04-18-009	S23	1				23	2	B	13	0			↓		16:27	25	11027			
04-18-009	S24	1				24	2	B	52	0	02404	09:25	02404	14:22	20	10764				
04-18-009	S25	1				25	2	B	2	0			↓		16:10	25	11573			
04-18-009	S26	1				26	2	B	2	0			↓		18:38	25	12779	11061 Q	6/23/04	
04-18-009	S27	1				27	2	B	2	0			↓		16:27	25	11027			
04-18-009	S28	1				28	2	B	2	0			↓							
04-18-009	S29	1				29	2	B	2	0			↓							
04-18-009	S30	1				30	2	B	2	0			↓							

QASS#

Std./ Spike Type	Carrier Vol. (ml)	Spike Vol. (ml)	Pipet No.
100.1572.47	Ra 226	2.0	E2011

Spiked by: Bob 6/10/04
 Spike Witness: Bob 6/10/04
 Reviewed by: _____

6/10/04.....10:35 AM

Sample ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count			Sample Count		
				Start Date	Time	Counts	Dur. Date	Time	Counts
Calib. Source	2B	1A					08:17/04	08:29	9449
	6C							08:30	9409
	4D						08:31	9295	✓
0405175.1	Delivery	6C	29	18	08:17/04	08:34	15		
	1D esp	4D	30		✓	5		14:31	6 15
	2	6C	31		✓	3		✓ 10	
RECDel3.1. MB	4D	20	19		09:21	3		15:06	7
	LCS	6C	21	✓	✓	3		✓ 4	
Calib. Source	1A	1A					15:33	1140	✓
	2B						17:21	9454	
	6C						17:22	9333	
	4D						17:23	9469	
	1A						17:24	9439	
	2B						09:27	9425	
	6C						09:28	9333	
	4D						09:29	9468	
041800. S1	1A	1	1A	08:21/04	09:29	18	15		09:30 9375
S2	2B	2	1			8			15:44 11215 25
S2	1A	2			09:44	17			✓ 10665 20
S1	2B	1							16:13 10678 20
S3	1A	3							✓ 10464 25
S4	2B	4			10:47	19			17:15 10515 20
S4	1A	4				5			✓ 17:192 35
									18:31 12410 25

Comments:

248268

Logbook No./Page

Logbook No./Page		Focus									
Sample ID	Scalar / Detector ID	Flask ID	Background Count				Start				Sample Count
			Start		Dur.	Pos.	Date	Time	Counts	Dur.	Pos.
			Date	Time	Counts	(min.)	Chk.		(min.)	Chk.	
0418009 · S3	2B	3	NA	6/21/04	11:13	8	15	✓	6/21/04	18:01	17322-25
Carib. SOURCE	1A	NA							6/22/04	08:26	9496 1
	2B								08:27	9475	
	6C								08:28	9460	
	4D								08:29	9421	✓
0418009 · S5	1A	9	NA	6/22/04	08:29	17	15	✓	14:50	16392	20
· S6	2B	7							16:18:00	25	
· S6	1A	7							15:31	11929	25
· S5	2B	6							15:31	11929	25
· S7	1A	8							12:11:00	25	
· S8	2B	9							17:24	10808	25
· S8	1A	9							17:24	10808	20
· S7	2B	8							10:30:08	20	
ClueS SOURCE	1A	NA									
	2B										
	6C										
	4D										
0418009 · S9	1A	10	NA	6/23/04	08:39	22	15	✓	08:30	9339	
· S10	2B	12							08:31	9292	
· S10	6C	1A							08:32	9490	✓
· S9	2B	10							16:10	10946	25
· S11	1A	13							11:57:33	25	
· S12	2B	14							17:15	11771	25

Comments:

Reviewed by/date:

Color

Sample ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count			Start Date	Dur. (min.)	Pos. Chk.	Sample Count		
				Start Time	Counts	Time				Start Date	Time	Counts (min.)
0418009.S12	1A	14	NA	08:23:04	09:51	23	15	08:23:04	18:38	12729	25	✓
✓ S11	2B	13	↓	↓	↓	11	↓	↓	↓	11:06:11	25	✓
✓ C115 SOURCE	1A	NA	—	—	—	—	—	—	—	—	—	—
✓	2B	—	—	—	—	—	—	—	—	—	—	—
✓	6C	—	—	—	—	—	—	—	—	—	—	—
✓	4D	—	—	—	—	—	—	—	—	—	—	—
0418009.S13	1A	2	NA	08:24:04	08:03	49	15	08:24:04	13:49	11277	20	✓
✓ S14	2B	9	↓	↓	34	—	—	↓	10:31:04	20	✓	✓
✓ S14	1A	9	—	—	—	—	—	—	—	—	—	—
✓ S13	2B	2	↓	↓	42	—	—	↓	14:24:11	20	✓	✓
✓ S15	1A	10	↓	↓	52	—	—	↓	10:46:04	20	✓	✓
✓ S15	2B	10	↓	↓	57	—	—	↓	15:21:11	25	✓	✓
0418009.1CV1	1A	1	—	—	34	—	—	—	14:16:12	11:02:17	25	✓
✓ 1CV2	2B	3	↓	↓	39	—	—	—	16:51:16	13:04:15	✓	✓
✓ C115 SOURCE	1A	NA	—	—	49	—	—	—	17:00:04	16:36:04	✓	✓
✓	2B	—	—	—	—	—	—	—	18:34:34	9452	✓	✓
✓	6C	—	—	—	—	—	—	—	18:35:35	94172	✓	✓
✓	4D	—	—	—	—	—	—	—	18:34:34	9473	✓	✓
✓	—	—	—	—	—	—	—	—	18:37:37	9472	✓	✓
✓	—	—	—	—	—	—	—	—	—	—	—	—
✓	—	—	—	—	—	—	—	—	—	—	—	—
✓	—	—	—	—	—	—	—	—	—	—	—	—
Comments:	G 024/04											

PROJECT Ra-226 working standard

Continued From Page _____

4mm 1-2859 467.1572.47

4600

Jacket primary Standard 467.1572.45 and dilute
 4mm 1-2859
 using 0.5 N HCl 4mm 1-2859

Balance 1/2 used

VOA initial: 65.8813 g

VOA final: 48.5167 g

amt transferred: 17.3646 g (Ra-226 primary standard)

bottle: 71.008 g Balance 1/2 used

55.7098 g (w/ Ra-226 primary standard)

Ra-226 1st std: 17.3646 g

38.3452 g (wt of empty bottle)

density of 0.5 N HCl Balance 1/2 used

empty vol. flask: 36.5852 g density =

50mL final: 86.7189 g 1.0027 g/mL

50.1337 g

Balance 2/1 used

final bottle: 516.29 g - 38.3452 g = 477.9448 g
 (empty bottle) solution

activity = 17.3646 g • 148.6 pCi/g = 25,803.7956 pCi

25,803.7956 pCi516.29 g - 477.9448 g = 53.99 pCi/g1mm 1-2859 × 1.00275 g/mL

54.136 pCi/mL

Std ID: 460.1572.47

Description: Ra-226 Working Solution

Activity: 54.136 pCi/mL

Uncertainty: 2.977 pCi/mL

Ref. Date: 1/1/93

Ref Time: na

Prep Date 6/8/99 Prep by: JMM

Expiration 6/7/04

Matrix/Comp. 0.5 N HCl

Half Life (y): 1.60E+08

Continued on Page

5/19
JMM

Read and Understood By

Signed

Date

Signed

Date

DCB 12/3/99

6/8/99

Dan C. Brown

12/3/99

000125

1/28/98 Open ampule sol#2557-4 (RSO#460), transfer to 40 ml VOA vial + dilute w/ 0.5 M HCl.

Diluent = 0.5 M HCl

Balance 12 used

- VOA start: 26.5345 g (empty)
- VOA final 65.8813 g (final, Ra-226 + 0.5 HCl)

Δ transferred: 39.3468 g

initial ampoule + beaker: 38.0054 g Balance 12 used
empty ampoule + beaker: 33.0913 g Ra-226
4.9141 g mass added to VOA

11,900 pCi/g
x 4.9141

58,477.79 pCi
- 39.35

1486 pCi/g final activity conc.

as of 1/93

$t_{1/2} = 1600 \text{ y}$

Total mass = ± 5.5%

standard verification balance = GEOMETRY 10

former jitters: 61.03 g

total wt: 181.33 g

$$181.33 - 61.03 =$$

120.30 g solution

Continued on Page

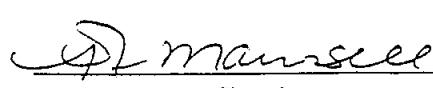
Read and Understood By



Signed

1/28/99

Date



Signed

2/3/99

000126 Date

Paragon ID 460
Recd 8-25-97

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide	Radium-226		Half-life	1600 years
Nominal activity	60	nano curies		
Nominal volume	5	ml in ampoule/bottle number	2557-4	

Measurement Activity of principal radionuclide

Activity per gram of this solution:

11.9	nano curies	of	Radium-226
at 0400 hours PST on			January 1993

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

	curies	Per gram
--	--------	----------

of the daughter nuclide

Total mass of this solution

Approximately 5.0	grams
-------------------	-------

Method of measurement

This standard was prepared by gravimetric dilution of NBS Standard Reference Material 4964-B. The specific activity of the dilution was determined by gamma spectrometry by comparing the sum of the activities of the 242, 352 and 609 KeV gamma ray emissions to those of several NBS SRM 4957 Radium-226 sources.

Useful Life

This radionuclide has decayed through half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after

Indefinite

000127

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1)

less than
equal to

%

of the principal activity

(2)

less than
equal to

%

of the principal activity

(3)

less than
equal to

%

of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than \pm 0.6 %

(The 99.7% confidence limits are given by $t(sm)$ where t is obtained from the student t factor for the degree of freedom ($n-1$)).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error ($+ \delta - \delta'$). These have been estimated not to exceed

+ 3.7 % or - 3.7 %

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error [$t(sm)$] at the 99.7% confidence limits and the worst case estimate of the systematic errors ($+ \delta - \delta'$)

The overall uncertainty is therefore calculated on the basis of $+ [t(sm) + \delta]$, $- [t(sm) + \delta]$ and is + 5.5 %, - 5.5 % of the quoted radioactive concentration.

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

Radium-226 is a member of the Uranium-238 decay chain. Radium-226 decays 100 percent by alpha emission to Radon-222.

Chemical Composition of Solution

Carrier content per gram of solution:

0.8 micrograms Ba

Other components:

0.5M HCl

Preservative:

Remarks

The measured value and the expected value using the gravimetric factors and the NBS calibration of SRM-4964B differed by 1.6 percent. The average of the two values was used for this standard.

Date Certificate Prepared

January 21, 1993

Approval Signature

Paul B. Tahn



U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide Radium-226
Source identification 2557-4, prepared by EMSL
Source description Liquid in 5-mL flame-sealed glass ampoule
Source mass Approximately 5.0 grams
Source composition Radium-226 plus 0.8 μg of non-radioactive barium per gram of 0.5 mol \cdot L $^{-1}$ HCl
Reference time 0700 EST January 1, 1993

	<u>NIST DATA</u>	<u>EMSL DATA</u>
Radioactivity concentration	447.5 Bq \cdot g $^{-1}$	440.3 Bq \cdot g $^{-1}$
Expanded uncertainty	2.5 percent ^{(1)*}	\pm 5.5 percent ⁽²⁾
Photon-emitting impurities (Activities at reference time)	None observed ⁽³⁾	None reported
Measuring instrument	NIST pressurized "4 π " γ ionization chamber A calibrated with SRM 4955	Dilution of SRM 4964-B verified using germanium spectrometer system
Half life	1600 \pm 7 years ⁽⁴⁾	
Difference from NIST		-1.61 percent ⁽⁵⁾

For the Director,

J.M. Robin Hutchinson, Group Leader
Radioactivity Group
Physics Laboratory

Gaithersburg, MD 20899
September 1994

*Notes on next page

(over)

000123

NOTES

(1) The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1297* (1993)].

(2) The combined standard uncertainty, $u_c = 1.24$ percent, is the quadratic combination of the standard deviation (or standard deviation of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a)	100 ionization chamber measurements on each of 2 samples	0.31 percent
b)	activity of SRM 4955-55	1.21 percent
c)	gravimetric	0.05 percent
d)	half-life propagation ($\Delta t = 25$ y)	0.005 percent

The expanded uncertainty, $U = 2.5$ percent, is obtained by multiplying u_c by a coverage factor of $k = 2$ and is assumed to provide an uncertainty interval of approximately 95 percent confidence.

(3) Overall uncertainty reported by EMSL.

(4) The limits of detection are:

$12.6 \gamma s^{-1} g^{-1}$ between 40 and 348 keV,
 $4.75 \gamma s^{-1} g^{-1}$ between 356 and 605 keV, and
 $1.58 \gamma s^{-1} g^{-1}$ between 613 and 1900 keV,

provided that impurity photons are separated in energy by four keV or more from the principle gamma-ray emissions of radium-226 and its daughters.

(5) Evaluated Nuclear Structure Data File (1990).

(6) This result demonstrates the traceability of EMSL to NIST, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NIST interagency agreement of April 1976, as amended.

For further information, please contact Jeffrey T. Cessna at 301-975-5539.

Source identification 2557-4

000130

Code #: 460.15.72.47

Name of Standard: Ra 226 Working Std.

Date: 12/1/99

Analyst: JASON MODEST

Aliquot for verification: Two 64.6 g Aliquots placed in GED II Y container

Work up: See Attached QASS

Expected activity and uncertainty: 53.99 pCi/g

Results of Counting and counting uncertainty: $\approx 57.5 \pm 11.25$
= 106.5% of expected

Radiochemistry Technical Manager: Dan HCB

Date: 12/3/99

Radiochemistry QA Manager: _____

Date: _____

ATT FM 718FC
(2/27/95)

• 000131

Gamma Spectroscopy Analysis Benchsheet

Spreadsheet Unprotected: NA

Batch ID: 23010gsw.xls
 Analyst: AV
 Prep. Date: 11-30-99
 SOP: 739 R3

Analytical Balance No.:
 Top Load Balance No.:

XXXX
 22

QASS/NCR: Y / N
 Pretreatment Y / N
 Batch: NA

Work Order Number	Client Sample ID	Collection Date	Aliquot	Report			Remarks	Det. No.	Geo. No.	Count Dur	Count Date
				Size	Units	Basis					
1	99-23-010 1	STD.VER	11-30-99	64.63	g	D	N/A	64.6	g	D	30min 12/1/99
2	99-23-010 2	STD.VER	see WO	64.64	g	D	N/A	64.6	g	D	SAME STD(DUP) 13/1/99
3	51							64.6	j	D	30min 13/1/99
4	52							64.6	j	D	30min 13/1/99
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											

Relinquished by: AV
 date: 11-30-99

Received by: Amy
 Date: 11/30/99

Reviewed by:
 Date:

000132

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH 99-23-010-1, 2TEST YMETHOD prep. std. ver.SOP NA (VERBAL)INSTRUCTION FROM
DCB)

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

99-23-010-01 and -02 are the

same stat. of R9-226 (# 460-1572.47)

As per DCB, Geo-11

S&G'd geometry was used to pack
this sample.

AN

TECHNICIAN/ANALYST AN DATE 11/30/99RESOURCE MANAGER A.M. Goyang DATE 11/30/99

FORM 302FC3.FRM (10-30-98)

171621

000133

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Std. verification Total Radium

Client Project Id:

Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-01

Date Collected: 11/30/99 12:00

Sample Matrix: Liquid

Date Analyzed: 12/01/99 08:48

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.3	BDL	U
Na-22	< 0.19	BDL	U
K-40	< 2.0	BDL	U
Sc-46	< 0.24	BDL	U
Cr-51	< 1.2	BDL	U
Mn-54	< 0.18	BDL	U
Co-56	< 0.32	BDL	U
Co-57	< 0.10	BDL	U
Co-58	< 0.18	BDL	U
Fe-59	< 0.31	BDL	U
Co-60	< 0.25	BDL	U
Zn-65	< 0.64	BDL	U
Sr-85	< 0.23	BDL	U
Nb-95	< 0.28	BDL	U
Ru-106	< 1.3	BDL	U
Ag-110m	< 0.14	BDL	U
Sb-124	< 0.20	BDL	U
Sb-125	< 0.41	BDL	U
I-131	< 0.18	BDL	U
Cs-134	< 0.24	BDL	U
Cs-137	< 0.18	BDL	U
Ce-139	< 0.12	BDL	U
Ce-144	< 0.77	BDL	U
Eu-152	< 1.1	BDL	U
Eu-154	< 0.53	BDL	U
Eu-155	< 0.47	BDL	U
Tl-208	< 0.18	BDL	U
Bi-212	< 2.0	BDL	U
Pb-212	< 0.24	BDL	
Bi-214	6.3 ± 1.2	18.9	
Pb-214	7.0 ± 1.3	18.0	
Ra-226	57 ± 11	18.8	

Data stored in file 10007826.SPC

Continued on next page...

000134

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Std. verification Total Radium

Client Project Id:

Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-01

Date Collected: 11/30/99 12:00

Sample Matrix: Liquid

Date Analyzed: 12/01/99 08:48

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 0.88	BDL	U
Ac-228	< 0.63	BDL	U
Pa-234m	< 31	BDL	U
Th-234	< 2.2	BDL	U
U-235	< 0.85	BDL	U
Am-241	< 0.74	BDL	U

Data stored in file 10007826.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ).
See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:

U = Result is less than the sample specific minimum detectable activity.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra 226 Std. Verification

Client Project Id:

Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D1

Date Collected: 11/30/99 12:00

Sample Matrix: Liquid

Date Analyzed: 12/01/99 09:25

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.9	BDL	U
Na-22	< 0.33	BDL	U
K-40	< 2.9	BDL	U
Sc-46	< 0.17	BDL	U
Cr-51	< 1.3	BDL	U
Mn-54	< 0.24	BDL	U
Co-56	< 0.57	BDL	U
Co-57	< 0.11	BDL	U
Co-58	< 0.20	BDL	U
Fe-59	< 0.57	BDL	U
Co-60	< 0.41	BDL	U
Zn-65	< 0.44	BDL	U
Sr-85	< 0.31	BDL	U
Nb-95	< 0.28	BDL	U
Ru-106	< 2.1	BDL	U
Ag-110m	< 0.26	BDL	U
Sb-124	< 0.24	BDL	U
Sb-125	< 0.57	BDL	U
I-131	< 0.18	BDL	U
Cs-134	< 0.26	BDL	U
Cs-137	< 0.30	BDL	U
Ce-139	< 0.12	BDL	U
Ce-144	< 1.0	BDL	U
Eu-152	< 2.3	BDL	U
Eu-154	< 0.92	BDL	U
Eu-155	< 0.63	BDL	U
Tl-208	< 0.27	BDL	U
Bi-212	< 3.0	BDL	U
Pb-212	< 0.32	BDL	U
Bi-214	5.5 ± 1.2	22.5	
Pb-214	5.6 ± 1.1	20.1	
Ra-226	62 ± 12	20.1	

Data stored in file 10007832.SPC

Continued on next page...

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra 226 Std. Verification

Client Project Id:

Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D1

Date Collected: 11/30/99 12:00

Sample Matrix: Liquid

Date Analyzed: 12/01/99 09:25

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 1.2	BDL	U
Ac-228	< 0.94	BDL	U
Pa-234m	< 48	BDL	U
Th-234	< 2.7	BDL	U
U-235	< 0.89	BDL	U
Am-241	< 1.1	BDL	U

Data stored in file 10007832.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ).
See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:

U = Result is less than the sample specific minimum detectable activity.

Remarks: Sample 99-23-010-D1 is a duplicate of 99-23-010-01.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Standard Verification Ra226.

Client Project Id:

Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-02

Date Collected: 11/30/99 12:00

Sample Matrix: LIQUID

Date Analyzed: 12/01/99 08:51

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.4	BDL	U
Na-22	< 0.33	BDL	U
K-40	< 3.8	BDL	U
Sc-46	< 0.24	BDL	U
Cr-51	< 1.5	BDL	U
Mn-54	< 0.27	BDL	U
Co-56	< 0.37	BDL	U
Co-57	< 0.12	BDL	U
Co-58	< 0.31	BDL	U
Fe-59	< 0.52	BDL	U
Co-60	< 0.43	BDL	U
Zn-65	< 0.85	BDL	U
Sr-85	< 0.33	BDL	U
Nb-95	< 0.37	BDL	U
Ru-106	< 2.3	BDL	U
Ag-110m	< 0.18	BDL	U
Sb-124	< 0.29	BDL	U
Sb-125	< 0.53	BDL	U
I-131	< 0.21	BDL	U
Cs-134	< 0.26	BDL	U
Cs-137	< 0.26	BDL	U
Ce-139	< 0.14	BDL	U
Ce-144	< 0.89	BDL	U
Eu-152	< 2.1	BDL	U
Eu-154	< 0.92	BDL	U
Eu-155	< 0.63	BDL	U
Tl-208	< 0.28	BDL	U
Bi-212	< 2.8	BDL	U
Pb-212	< 0.29	BDL	U
Bi-214	6.5 ± 1.4	21.0	
Pb-214	6.7 ± 1.3	19.4	
Ra-226	57 ± 12	20.4	

Data stored in file 10007827.SPC

Continued on next page...

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GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Standard Verification Ra226.

Client Project Id:

Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-02

Date Collected: 11/30/99 12:00

Sample Matrix: LIQUID

Date Analyzed: 12/01/99 08:51

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 1.4	BDL	U
Ac-228	< 1.1	BDL	U
Pa-234m	< 57	BDL	U
Th-234	< 2.6	BDL	U
U-235	< 1.0	BDL	U
Am-241	< 1.1	BDL	U

Data stored in file 10007827.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ).
See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:

U = Result is less than the sample specific minimum detectable activity.

000133

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra226 Std.Verification

Client Project Id:

Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D2

Date Collected: 11/30/99 12:00

Sample Matrix:

Date Analyzed: 12/01/99 09:23

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.3	BDL	U
Na-22	< 0.20	BDL	U
K-40	< 2.9	BDL	U
Sc-46	< 0.19	BDL	U
Cr-51	< 1.2	BDL	U
Mn-54	< 0.17	BDL	U
Co-56	< 0.32	BDL	U
Co-57	< 0.092	BDL	U
Co-58	< 0.16	BDL	U
Fe-59	< 0.43	BDL	U
Co-60	< 0.21	BDL	U
Zn-65	< 0.61	BDL	U
Sr-85	< 0.24	BDL	U
Nb-95	< 0.26	BDL	U
Ru-106	< 1.7	BDL	U
Ag-110m	< 0.15	BDL	U
Sb-124	< 0.23	BDL	U
Sb-125	< 0.49	BDL	U
I-131	< 0.17	BDL	U
Cs-134	< 0.24	BDL	U
Cs-137	< 0.21	BDL	U
Ce-139	< 0.11	BDL	U
Ce-144	< 0.84	BDL	U
Eu-152	< 1.3	BDL	U
Eu-154	< 0.56	BDL	U
Eu-155	< 0.48	BDL	U
Tl-208	< 0.22	BDL	U
Bi-212	< 2.3	BDL	U
Pb-212	< 0.25	BDL	
Bi-214	7.4 ± 1.4	18.5	
Pb-214	7.0 ± 1.3	18.0	
Ra-226	54 ± 10	19.2	

Data stored in file 10007831.SPC

Continued on next page...

000140

GAMMA SPECTROMETRY RESULTS SUMMARY
Method 901.1 (Modified)

Client Name: Ra226 Std.Verification

Client Project Id:

Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D2

Date Collected: 11/30/99 12:00

Sample Matrix:

Date Analyzed: 12/01/99 09:23

Count Duration: 30 Min.

Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 0.84	BDL	U
Ac-228	< 0.60	BDL	U
Pa-234m	< 37	BDL	U
Th-234	< 2.6	BDL	U
U-235	< 0.82	BDL	U
Am-241	< 0.73	BDL	U

Data stored in file 10007831.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ).
See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:

U = Result is less than the sample specific minimum detectable activity.

Remarks: Sample 99-23-010-D2 is a duplicate of 99-23-010-02.

000141

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DR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2
=====

Sample ID : 99-23-010-02 B:STD.ACT.VERIFC.

ample Size 1.00e+000 Sample | Spectrum File GDR03.SPC
ampling Start 11-30-99 12:00 | Counting Start 12-01-99 08:51
ampling Stop 11-30-99 12:00 | Live Time 1800 Sec
urrent Date 12-01-99 08:16 | Real Time 1806 Sec

Detector #: 3
nergy(keV) = -0.52 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

WHM(keV) = 0.80 + 0.011*En + 6.71e-004*En^2 + 0.00e+000*En^3 11-08-99 11:57
Where En = Sqrt(Energy in keV)

sensitivity 0.20 | Search Start / End. 30 / 4000
igma Multiplier. 2.00 |

PEAK SEARCH RESULTS

K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.77	150.34	46	38	33	129	1.05	a
2	77.17	155.13	116	39	28	115	0.96	b
3	86.89	174.53	22	36	32	125	0.48	NET < CL
4	186.13	372.68	443	52	27	89	1.16	
5	238.37	477.00	14	17	13	31	0.66	a
6	241.98	484.20	126	31	19	47	1.15	b
7	295.18	590.44	203	37	22	52	1.33	
8	351.81	703.50	357	43	19	40	1.23	
9	379.29	758.37	18	17	14	22	1.28	
10	486.19	971.82	10	16	14	18	0.85	NET < CL
11	511.04	1021.44	39	21	16	27	2.52	
12	609.27	1217.58	272	37	15	21	1.61	
13	768.42	1535.36	28	17	13	16	1.36	
14	934.00	1865.98	13	14	11	13	1.06	
15	989.85	1977.50	5	13	11	11	1.11	NET < CL
16	1120.22	2237.82	46	18	11	9	1.74	
17	1238.12	2473.24	22	11	6	4	1.88	
18	1315.24	2627.22	5	9	7	4	0.60	NET < CL
19	1400.32	2797.10	10	6	0	0	2.35	
20	1408.58	2813.61	19	9	0	0	2.23	
21	1764.67	3524.62	39	14	5	2	2.06	

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DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
=====
 BACKGROUND SUBTRACT RESULTS
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ample ID : 99-23-010-02 B:STD.ACT.VERIFIC.

kg File: DET03.bkg | Counting Start. 12-01-99 08:51
D.: 99-23-006-03 B:11/29/99 WK.BKG | Current Date 12-01-99 08:16

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN- CERTAINTY	NEW NET COUNTS	NEW UN- CERTAINTY	FLAG
4	186.13	1.16	443	52	431	52	
5	238.37	0.66	14	17	11	18	NET < CL
8	351.81	1.23	357	43	347	43	
11	511.04	2.52	39	21	-7	22	NET < CL
12	609.27	1.61	272	37	265	37	
21	1764.67	2.06	39	14	37	14	

000143

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DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
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NUCLIDE ACTIVITY SUMMARY

ample ID: 99-23-010-02 B:STD.ACT.VERIFC.

ample Size	1.00e+000 Sample	Spectrum File	GDR03.SPC
ampling Start.	11-30-99 12:00	Counting Start.	12-01-99 08:51
ampling Stop	11-30-99 12:00	Buildup Time.	0.00e+000 Hrs
urrent Date.	12-01-99 08:16	Decay Time.	2.09e+001 Hrs
fficiency File.	DET0311.EFF	Library File.	FANPR6.LIB
D.	GEO11 534	IDFiss. Act. and Nat. Library	RTS 02/17
ff. = 1/[2.28e-003*En^-3.58e+000 + 7.58e+001*En^8.58e-001]			08-25-99 14:19
Gamma Fraction Limit >= 75.00 %		Decay Limit <=. . . . 8.000 Halflives	
library Energy Tolerance. . . . 2.00			

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	8.24e+003 +-9.94e+002	1.40e+007	1 of 1
Pb-214	Average:	9.58e+002 +-9.87e+001	1.40e+007	2 of 2
	295.21	9.45e+002 +-1.72e+002		
	351.92	9.64e+002 +-1.21e+002		
Bi-214	Average:	9.31e+002 +-1.22e+002	1.40e+007	2 of 2
	609.31	9.46e+002 +-1.31e+002		
	1120.29	8.42e+002 +-3.23e+002		
Am-241	59.54	< 1.60e+002	3.79e+006	MDA
Eu-155	86.55	< 9.01e+001	4.34e+004	MDA
Th-234	92.60	< 3.67e+002	3.91e+013	MDA
Co-57	122.06	< 1.76e+001	6.50e+003	MDA
Ce-144	133.54	< 1.27e+002	6.82e+003	MDA
U-235	143.76	< 1.46e+002	6.17e+012	MDA
Ce-139	165.85	< 2.01e+001	3.30e+003	MDA
Th-227	236.00	< 1.97e+002	1.91e+005	MDA
Pb-212	238.63	< 4.10e+001	1.67e+004	MDA
Cr-51	320.08	< 2.16e+002	6.65e+002	MDA
I-131	364.48	< 3.07e+001	1.93e+002	MDA
Sb-125	427.89	< 7.59e+001	2.43e+004	MDA
Be-7	477.59	< 1.95e+002	1.28e+003	MDA
Sr-85	513.99	< 4.77e+001	1.56e+003	MDA
Tl-208	583.14	< 4.03e+001	1.67e+004	MDA
Sb-124	602.71	< 4.14e+001	1.44e+003	MDA
Cs-134	604.70	< 3.78e+001	1.81e+004	MDA
Ru-106	621.84	< 3.35e+002	8.84e+003	MDA
Ag-110m	657.75	< 2.64e+001	6.00e+003	MDA
Cs-137	661.65	< 3.78e+001	2.64e+005	MDA
Bi-212	727.17	< 4.04e+002	1.67e+004	MDA
Nb-95	765.79	< 5.37e+001	1.54e+003	MDA
Co-58	810.76	< 4.44e+001	1.70e+003	MDA
Mn-54	834.83	< 3.92e+001	7.50e+003	MDA

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-46	889.25	< 3.42e+001	2.01e+003	MDA
-228	911.07	< 1.52e+002	5.04e+004	MDA
-234m	1001.03	< 8.11e+003	3.91e+013	MDA
-59	1099.22	< 7.43e+001	1.07e+003	MDA
-65	1115.52	< 1.22e+002	5.87e+003	MDA
-60	1173.22	< 6.18e+001	4.62e+004	MDA
-56	1238.25	< 5.24e+001	1.89e+003	MDA
-154	1274.45	< 1.32e+002	7.71e+004	MDA
-22	1274.54	< 4.71e+001	2.28e+004	MDA
-152	1407.95	< 3.00e+002	1.19e+005	MDA
-40	1460.81	< 5.44e+002	1.12e+013	MDA

TOTAL: 1.01e+004 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un- Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.77	150.34	46	38	33	129	1.05	8.293e-001
77.17	155.13	116	39	28	115	0.96	1.943e+000
241.98	484.20	126	31	19	47	1.15	1.594e+000
379.29	758.37	18	17	14	22	1.28	3.250e-001
768.42	1535.36	28	17	13	16	1.36	9.405e-001
934.00	1865.98	13	14	11	13	1.06	5.188e-001
238.12	2473.24	22	11	6	4	1.88	1.111e+000
400.32	2797.10	10	6	0	0	2.35	5.621e-001
408.58	2813.61	19	9	0	0	2.23	1.073e+000
764.67	3524.63	37	14	5	2	2.06	2.534e+000

=====
DR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2
=====

ample ID : 99-23-010-01 B:TOTAL RA.STD.ACT.VER

ample Size 1.00e+000 Sample | Spectrum File GDR01.SPC
ampling Start. . . . 11-30-99 12:00 | Counting Start. 12-01-99 08:48
ampling Stop 11-30-99 12:00 | Live Time 1800 Sec
urrent Date. 12-01-99 08:12 | Real Time 1806 Sec

Detector #: 1

nergy(keV) = -1.41 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

WHM(keV) = 1.15 + -0.013*En + 1.64e-003*En^2 +-1.10e-005*En^3 11-08-99 09:40
Where En = Sqrt(Energy in keV)

sensitivity 0.20 | Search Start / End. 60 / 4000
igma Multiplier. 2.00 |

PEAK SEARCH RESULTS

K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.76	152.07	105	55	48	229	1.21	a
2	77.01	156.57	216	53	39	210	1.15	b
3	83.49	169.50	18	36	30	142	0.59	a NET < CL
4	87.06	176.62	62	46	38	202	1.08	b
5	186.06	374.27	823	70	36	147	1.31	
6	241.80	485.55	191	46	33	128	1.00	
7	295.10	591.96	411	53	33	106	1.18	
8	323.10	647.86	6	31	28	82	0.32	NET < CL
9	351.73	705.01	788	64	28	81	1.33	
10	511.16	1023.30	117	37	29	76	2.14	
11	609.22	1219.07	580	56	26	70	1.87	
12	768.45	1536.95	69	28	22	41	1.42	
13	934.04	1867.54	36	22	18	26	2.36	
14	1104.88	2208.60	21	16	13	14	3.31	
15	1120.22	2239.23	144	33	22	37	2.16	
16	1237.99	2474.35	68	21	13	14	1.88	
17	1377.52	2752.90	32	23	20	27	2.86	
18	1401.33	2800.45	21	19	16	20	13.60	
19	1460.96	2919.48	48	23	18	25	1.49	
20	1729.26	3455.12	37	21	16	20	3.07	
21	1764.14	3524.74	154	28	14	11	3.09	
22	1847.60	3691.38	24	15	11	8	2.50	

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DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
=====
 BACKGROUND SUBTRACT RESULTS
=====

ample ID : 99-23-010-01 B:TOTAL RA.STD.ACT.VER

kg File: det01.bkg | Counting Start. 12-01-99 08:48
D.: 99-23-006-01 B:11/29/99 WK. BK | Current Date 12-01-99 08:12

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN- CERTAINTY	NEW NET COUNTS	NEW UN- CERTAINTY	FLAG
5	186.06	1.31	823	70	789	70	
7	295.10	1.18	411	53	402	54	
9	351.73	1.33	788	64	767	64	
10	511.16	2.14	117	37	-20	39	NET < CL
11	609.22	1.87	580	56	562	57	
17	1377.52	2.86	32	23	29	23	
19	1460.96	1.49	48	23	0	24	NET < CL
21	1764.14	3.09	154	28	147	29	

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OR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
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NUCLIDE ACTIVITY SUMMARY

Sample ID: 99-23-010-01 B:TOTAL RA.STD.ACT.VER

Sample Size	1.00e+000	Sample	Spectrum File	GDR01.SPC
Sampling Start. . . .	11-30-99 12:00		Counting Start.	12-01-99 08:48
Sampling Stop	11-30-99 12:00		Buildup Time.	0.00e+000 Hrs
Current Date.	12-01-99 08:12		Decay Time.	2.08e+001 Hrs
Efficiency File.	DET0111.EFF		Library File.	FANPR6.LIB
D.	Geo11 #534		IDFiss. Act. and Nat. Library	RTS 02/17
ff.=	1/[2.85e-003*En^3.16e+000 + 3.06e+001*En^6.85e-001]			08-30-99 08:13
amma Fraction Limit >=	75.00 %	Decay Limit <=. . . .	8.000 Halflives	
library Energy Tolerance. . . .	2.00			

FINAL ACTIVITY REPORT

nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
La-226	186.21	8.23e+003 +- 7.35e+002	1.40e+007	1 of 1
'b-214	Average:	1.00e+003 +- 7.15e+001	1.40e+007	2 of 2
	295.21	9.35e+002 +- 1.26e+002		
	351.92	1.03e+003 +- 8.69e+001		
'i-214	Average:	9.04e+002 +- 8.33e+001	1.40e+007	2 of 2
	609.31	8.83e+002 +- 8.89e+001		
	1120.29	1.05e+003 +- 2.39e+002		
'm-241	59.54	< 1.06e+002	3.79e+006	MDA
'u-155	86.55	< 6.79e+001	4.34e+004	MDA
'h-234	92.60	< 3.22e+002	3.91e+013	MDA
'o-57	122.06	< 1.48e+001	6.50e+003	MDA
'e-144	133.54	< 1.11e+002	6.82e+003	MDA
J-235	143.76	< 1.21e+002	6.17e+012	MDA
'e-139	165.85	< 1.69e+001	3.30e+003	MDA
'h-227	236.00	< 1.26e+002	1.91e+005	MDA
?b-212	238.63	< 3.42e+001	1.67e+004	MDA
Cr-51	320.08	< 1.76e+002	6.65e+002	MDA
I-131	364.48	< 2.52e+001	1.93e+002	MDA
Sb-125	427.89	< 5.90e+001	2.43e+004	MDA
Se-7	477.59	< 1.83e+002	1.28e+003	MDA
Sr-85	513.99	< 3.32e+001	1.56e+003	MDA
Rl-208	583.14	< 2.59e+001	1.67e+004	MDA
Sb-124	602.71	< 2.92e+001	1.44e+003	MDA
Cs-134	604.70	< 3.50e+001	1.81e+004	MDA
Ru-106	621.84	< 1.84e+002	8.84e+003	MDA
Ag-110m	657.75	< 1.99e+001	6.00e+003	MDA
Cs-137	661.65	< 2.65e+001	2.64e+005	MDA
Bi-212	727.17	< 2.93e+002	1.67e+004	MDA
Nb-95	765.79	< 4.06e+001	1.54e+003	MDA
Co-58	810.76	< 2.63e+001	1.70e+003	MDA
Mn-54	834.83	< 2.56e+001	7.50e+003	MDA

-46	889.25	< 3.37e+001	2.01e+003	MDA
-228	911.07	< 8.97e+001	5.04e+004	MDA
-234m	1001.03	< 4.47e+003	3.91e+013	MDA
-59	1099.22	< 4.39e+001	1.07e+003	MDA
-65	1115.52	< 9.17e+001	5.87e+003	MDA
-60	1173.22	< 3.59e+001	4.62e+004	MDA
-56	1238.25	< 4.60e+001	1.89e+003	MDA
-154	1274.45	< 7.62e+001	7.71e+004	MDA
-22	1274.54	< 2.71e+001	2.28e+004	MDA
-152	1407.95	< 1.62e+002	1.19e+005	MDA
-40	1460.81	< 2.87e+002	1.12e+013	MDA

TOTAL: 1.01e+004 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un- Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.76	152.07	105	55	48	229	1.21	9.091e-001
77.01	156.57	216	53	39	210	1.15	1.769e+000
87.06	176.62	62	46	38	202	1.08	4.184e-001
241.80	485.55	191	46	33	128	1.00	1.258e+000
768.45	1536.94	69	28	22	41	1.42	9.780e-001
934.04	1867.54	36	22	18	26	2.36	5.823e-001
104.88	2208.60	21	16	13	14	3.31	3.818e-001
237.99	2474.35	68	21	13	14	1.88	1.339e+000
377.52	2752.90	29	23	20	27	2.86	6.213e-001
401.33	2800.45	21	19	16	20	13.60	4.485e-001
729.26	3455.12	37	21	16	20	3.07	9.158e-001
764.14	3524.74	147	29	14	11	3.09	3.688e+000
847.60	3691.38	24	15	11	8	2.50	6.216e-001

=====
DR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2
=====

ample ID : 99-23-010-D1 B:RA226 STD.VER.

ample Size 1.00e+000 Sample | Spectrum File GDR03.SPC
ampling Start. . . . 11-30-99 12:00 | Counting Start. 12-01-99 09:25
ampling Stop 11-30-99 12:00 | Live Time 1800 Sec
urrent Date. 12-01-99 08:50 | Real Time 1806 Sec

Detector #: 3

nergy(keV) = -0.52 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

WHM(keV) = 0.80 + 0.011*En + 6.71e-004*En^2 + 0.00e+000*En^3 11-08-99 11:57
Where En = Sqrt(Energy in keV)

sensitivity 0.20 | Search Start / End. 30 / 4000
igma Multiplier. 2.00 |

PEAK SEARCH RESULTS

K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.80	150.39	60	36	30	106	0.90	a
2	77.13	155.05	87	36	26	108	0.94	b
3	87.25	175.25	28	28	23	81	0.66	
4	186.21	372.85	476	53	27	82	1.07	
5	238.61	477.48	25	27	24	50	1.38	a
6	241.89	484.03	96	30	21	48	1.49	b
7	295.12	590.32	181	36	22	55	1.19	
8	351.86	703.60	294	39	17	36	1.29	
9	511.43	1022.24	34	25	21	39	3.20	
10	609.22	1217.48	231	35	17	29	1.37	
11	768.67	1535.86	18	17	14	17	1.93	
12	933.79	1865.57	18	13	9	8	2.70	
13	1120.23	2237.84	40	21	16	22	2.28	
14	1238.02	2473.03	25	16	12	12	3.72	
15	1378.11	2752.76	11	11	9	6	2.05	
16	1450.72	2897.75	4	8	7	4	1.03	NET < CL
17	1461.53	2919.32	8	11	9	7	1.12	NET < CL
18	1764.42	3524.11	55	16	6	3	2.90	

000150

=====
DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
=====

BACKGROUND SUBTRACT RESULTS

ample ID : 99-23-010-D1 B:RA226 STD.VER.

kg File: DET03.bkg | Counting Start. 12-01-99 09:25
D.: 99-23-006-03 B:11/29/99 WK.BKG | Current Date 12-01-99 08:50

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN- CERTAINTY	NEW NET COUNTS	NEW UN- CERTAINTY	FLAG
4	186.21	1.07	476	53	464	53	
5	238.61	1.38	25	27	19	27	NET < CL
8	351.86	1.29	294	39	284	40	
9	511.43	3.20	34	25	-12	26	NET < CL
10	609.22	1.37	231	35	224	36	
17	1461.53	1.12	8	11	0	12	NET < CL
18	1764.42	2.90	55	16	53	16	

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DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
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NUCLIDE ACTIVITY SUMMARY

ample ID: 99-23-010-D1 B:RA226 STD.VER.

ample Size 1.00e+000 Sample | Spectrum File GDR03.SPC
ampling Start. . . . 11-30-99 12:00 | Counting Start. 12-01-99 09:25
ampling Stop 11-30-99 12:00 | Buildup Time. 0.00e+000 Hrs
urrent Date. 12-01-99 08:50 | Decay Time. 2.14e+001 Hrs

fficiency File. DET0311.EFF | Library File. FANPR6.LIB
D. GEO11 534 | IDFiss. Act. and Nat. Library RTS 02/17

ff.= 1/[2.28e-003*En^-3.58e+000 + 7.58e+001*En^8.58e-001] 08-25-99 14:19

amma Fraction Limit >= 75.00 % | Decay Limit <=. . . . 8.000 Halflives
library Energy Tolerance. . . . 2.00
=====

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	8.89e+003 +-1.02e+003	1.40e+007	1 of 1
Pb-214	Average:	8.05e+002 +-9.20e+001	1.40e+007	2 of 2
	295.21	8.40e+002 +-1.68e+002		
	351.92	7.89e+002 +-1.10e+002		
Bi-214	Average:	7.92e+002 +-1.21e+002	1.40e+007	2 of 2
	609.31	7.98e+002 +-1.28e+002		
	1120.29	7.44e+002 +-3.85e+002		
Am-241	59.54	< 1.62e+002	3.79e+006	MDA
Eu-155	86.55	< 9.01e+001	4.34e+004	MDA
Th-234	92.60	< 3.82e+002	3.91e+013	MDA
Co-57	122.06	< 1.62e+001	6.50e+003	MDA
Ce-144	133.54	< 1.44e+002	6.82e+003	MDA
J-235	143.76	< 1.28e+002	6.17e+012	MDA
Ce-139	165.85	< 1.73e+001	3.30e+003	MDA
Th-227	236.00	< 1.66e+002	1.91e+005	MDA
Pb-212	238.63	< 4.59e+001	1.67e+004	MDA
Cr-51	320.08	< 1.90e+002	6.65e+002	MDA
I-131	364.48	< 2.58e+001	1.93e+002	MDA
Sb-125	427.89	< 8.17e+001	2.43e+004	MDA
Be-7	477.59	< 2.67e+002	1.28e+003	MDA
Sr-85	513.99	< 4.39e+001	1.56e+003	MDA
Tl-208	583.14	< 3.92e+001	1.67e+004	MDA
Sb-124	602.71	< 3.40e+001	1.44e+003	MDA
Cs-134	604.70	< 3.68e+001	1.81e+004	MDA
Ru-106	621.84	< 2.99e+002	8.84e+003	MDA
Ag-110m	657.75	< 3.77e+001	6.00e+003	MDA
Cs-137	661.65	< 4.32e+001	2.64e+005	MDA
Bi-212	727.17	< 4.24e+002	1.67e+004	MDA
Nb-95	765.79	< 3.96e+001	1.54e+003	MDA
Co-58	810.76	< 2.91e+001	1.70e+003	MDA
Mn-54	834.83	< 3.47e+001	7.50e+003	MDA

000152

-46	889.25	< 2.39e+001	2.01e+003	MDA
-228	911.07	< 1.35e+002	5.04e+004	MDA
-234m	1001.03	< 6.84e+003	3.91e+013	MDA
-59	1099.22	< 8.15e+001	1.07e+003	MDA
-65	1115.52	< 6.29e+001	5.87e+003	MDA
-60	1173.22	< 5.87e+001	4.62e+004	MDA
-56	1238.25	< 8.18e+001	1.89e+003	MDA
-154	1274.45	< 1.32e+002	7.71e+004	MDA
-22	1274.54	< 4.71e+001	2.28e+004	MDA
-152	1407.95	< 3.24e+002	1.19e+005	MDA
-40	1460.81	< 4.11e+002	1.12e+013	MDA

TOTAL: 1.05e+004 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un- Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.80	150.39	60	36	30	106	0.90	1.082e+000
77.13	155.05	87	36	26	108	0.94	1.454e+000
87.25	175.25	28	28	23	81	0.66	3.567e-001
241.89	484.03	96	30	21	48	1.49	1.221e+000
768.67	1535.86	18	17	14	17	1.93	5.990e-001
933.79	1865.57	18	13	9	8	2.70	7.299e-001
238.02	2473.03	25	16	12	12	3.72	1.258e+000
378.11	2752.76	11	11	9	6	2.05	5.958e-001
764.42	3524.11	53	16	6	3	2.90	3.598e+000

DR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

Sample ID : 99-23-010-D2 B:RA226 STD.VER.

ample Size . . .	1.00e+000	Sample	Spectrum File	GDR01.SPC
ampling Start . . .	11-30-99 12:00		Counting Start	12-01-99 09:23
ampling Stop . . .	11-30-99 12:00		Live Time	1800 Sec
urrent Date . . .	12-01-99 08:48		Real Time	1806 Sec

Detector #: 1

nergy(keV) = -1.41 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

NHWM(keV) = 1.15 + -0.013*En + 1.64e-003*En^2 +-1.10e-005*En^3 11-08-99 09:40
Where En = Sqrt(Energy in keV)

sensitivity	0.20	Search Start / End.	60 / 4000
igma Multiplier.	2.00		

PEAK SEARCH RESULTS

K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.67	151.90	125	47	36	177	0.93	a
2	77.02	156.59	232	51	36	192	0.98	b
3	87.10	176.71	-3	49	43	256	0.04	NET < CL
4	186.02	374.18	771	72	42	198	1.17	
5	241.96	485.86	165	46	35	133	1.20	
6	295.15	592.05	470	56	34	116	1.22	
7	351.71	704.97	749	64	32	101	1.53	
8	510.77	1022.52	184	37	24	48	2.53	
9	609.16	1218.94	655	60	29	85	1.77	
10	768.69	1537.43	84	28	20	33	1.83	
11	934.35	1868.16	22	23	20	36	2.63	
12	1120.25	2239.29	194	33	16	21	2.42	
13	1238.21	2474.79	57	25	20	30	1.92	
14	1377.87	2753.60	28	23	20	30	1.51	
15	1461.34	2920.24	61	27	22	30	2.54	
16	1510.06	3017.51	19	18	15	16	3.00	
17	1729.27	3455.13	43	18	12	11	3.83	
18	1764.40	3525.27	133	29	17	18	2.41	

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DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
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BACKGROUND SUBTRACT RESULTS
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ample ID : 99-23-010-D2 B:RA226 STD.VER.

bg File: det01.bkg | Counting Start. 12-01-99 09:23
D.: 99-23-006-01 B:11/29/99 WK. BK | Current Date 12-01-99 08:48

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN- CERTAINTY	NEW NET COUNTS	NEW UN- CERTAINTY	FLAG
4	186.02	1.17	771	72	737	73	
6	295.15	1.22	470	56	461	57	
7	351.71	1.53	749	64	728	65	
8	510.77	2.53	184	37	47	39	
9	609.16	1.77	655	60	637	61	
14	1377.87	1.51	28	23	25	23	
15	1461.34	2.54	61	27	13	27	NET < CL
18	1764.40	2.41	133	29	126	29	

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DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a
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NUCLIDE ACTIVITY SUMMARY

ample ID: 99-23-010-D2 B:RA226 STD.VER.

ample Size	1.00e+000 Sample	Spectrum File	GDR01.SPC
ampling Start. . . .	11-30-99 12:00	Counting Start.	12-01-99 09:23
ampling Stop	11-30-99 12:00	Buildup Time.	0.00e+000 Hrs
urrent Date.	12-01-99 08:48	Decay Time.	2.14e+001 Hrs
fficiency File.	DET0111.EFF	Library File.	FANPR6.LIB
D.	Ge011 #534	IDFiss. Act. and Nat. Library	RTS 02/17
ff.= 1 / [2.85e-003*En^-3.16e+000 + 3.06e+001*En^6.85e-001]			08-30-99 08:13
amma Fraction Limit >=	75.00 %	Decay Limit <=	8.000 Halflives
library Energy Tolerance.	2.00		

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	7.68e+003 +-7.60e+002	1.40e+007	1 of 1
Pb-214	Average:	1.01e+003 +-7.32e+001	1.40e+007	2 of 2
	295.21	1.07e+003 +-1.33e+002		
	351.92	9.82e+002 +-8.76e+001		
Bi-214	Average:	1.06e+003 +-8.85e+001	1.40e+007	2 of 2
	609.31	1.00e+003 +-9.53e+001		
	1120.29	1.42e+003 +-2.38e+002		
Am-241	59.54	< 1.05e+002	3.79e+006	MDA
Eu-155	86.55	< 6.95e+001	4.34e+004	MDA
Rh-234	92.60	< 3.67e+002	3.91e+013	MDA
Co-57	122.06	< 1.32e+001	6.50e+003	MDA
Ce-144	133.54	< 1.21e+002	6.82e+003	MDA
J-235	143.76	< 1.17e+002	6.17e+012	MDA
Ce-139	165.85	< 1.64e+001	3.30e+003	MDA
Th-227	236.00	< 1.20e+002	1.91e+005	MDA
Pb-212	238.63	< 3.64e+001	1.67e+004	MDA
Cr-51	320.08	< 1.76e+002	6.65e+002	MDA
I-131	364.48	< 2.46e+001	1.93e+002	MDA
Sb-125	427.89	< 7.01e+001	2.43e+004	MDA
Be-7	477.59	< 1.86e+002	1.28e+003	MDA
Sr-85	513.99	< 3.47e+001	1.56e+003	MDA
Tl-208	583.14	< 3.14e+001	1.67e+004	MDA
Sb-124	602.71	< 3.26e+001	1.44e+003	MDA
Cs-134	604.70	< 3.47e+001	1.81e+004	MDA
Ru-106	621.84	< 2.37e+002	8.84e+003	MDA
Ag-110m	657.75	< 2.20e+001	6.00e+003	MDA
Cs-137	661.65	< 3.06e+001	2.64e+005	MDA
Bi-212	727.17	< 3.30e+002	1.67e+004	MDA
Nb-95	765.79	< 3.70e+001	1.54e+003	MDA
Co-58	810.76	< 2.31e+001	1.70e+003	MDA
Mn-54	834.83	< 2.49e+001	7.50e+003	MDA

000156

-46	889.25	< 2.76e+001	2.01e+003	MDA
-228	911.07	< 8.67e+001	5.04e+004	MDA
-234m	1001.03	< 5.26e+003	3.91e+013	MDA
-59	1099.22	< 6.15e+001	1.07e+003	MDA
-65	1115.52	< 8.76e+001	5.87e+003	MDA
-60	1173.22	< 3.06e+001	4.62e+004	MDA
-56	1238.25	< 4.60e+001	1.89e+003	MDA
-154	1274.45	< 8.03e+001	7.71e+004	MDA
-22	1274.54	< 2.85e+001	2.28e+004	MDA
-152	1407.95	< 1.91e+002	1.19e+005	MDA
-40	1460.81	< 4.17e+002	1.12e+013	MDA

TOTAL: 9.75e+003 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un- Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.67	151.90	125	47	36	177	0.93	1.086e+000
77.02	156.59	232	51	36	192	0.98	1.898e+000
241.96	485.86	165	46	35	133	1.20	1.083e+000
510.77	1022.52	47	39	24	48	2.53	5.089e-001
768.69	1537.43	84	28	20	33	1.83	1.198e+000
934.35	1868.16	22	23	20	36	2.63	3.573e-001
238.21	2474.79	57	25	20	30	1.92	1.116e+000
377.87	2753.60	25	23	20	30	1.51	5.226e-001
510.06	3017.51	19	18	15	16	3.00	4.286e-001
729.27	3455.13	43	18	12	11	3.83	1.073e+000
764.40	3525.27	126	29	17	18	2.41	3.162e+000

Radiochemistry Solution Report

Solution ID:	460.1572.47	Name:	Ra-226 Intermediate Standard
Units:	mL	Location:	London Name: [REDACTED]
Mainx:	LIQUID	ExpireDate:	6/7/04

Comment:

Component Name	Volume Added	Units
Ra-226 Intermediate Standard	460.1572.45	g

Calibrated Primary	Calibration Date	Reference	
Act/Conc	Date	1/2 Life (Yrs)	Final Act/Conc
11900	1/1/93	1/14/04	1600
Ra-226			53.8844821813323

Associated Parent IDs

460	460.1572.45
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Parent Solutions Sub Report

CompName	Final Vol:	Units:	Matrix:	Calibration Date	Reference Date	Decay Corrected Act/Conc	Units
Ra-226	460	g	LIQUID	1/1/93	1/14/04	11843.2551719227	pCi/g
Ra-226	460.1572.45	g	LIQUID	1/1/93	1/14/04	1479.12137571274	pCi/g

Abbreviations: NC = Not Calculated for reagents when the volume added is not entered.

NE = Not Entered

Date Printed: Wednesday, January 14, 2004

Paragon Analytics Inc.
Standards DB Version: 1.074

Code #: 460.15.72.47

Name of Standard: Ra 226 Working Std.

Date: 12/1/99

Analyst: JASON MODEST

Aliquot for verification: Two 64.6 g Aliquots placed in GEO 11 Y container

Work up: See Attached QASS

Expected activity and uncertainty: 53.99 pCi/g

Results of Counting and counting uncertainty: $\approx 57.5 \pm 11.25$
= 106.5 % of expected

Radiochemistry Technical Manager: Daniel C. Brown Date: 12/3/99

Radiochemistry QA Manager: _____ Date: _____

ATT FM 718FC
(2/27/95)

000159

1/28/98 Open ampule sol#2557-4 (RSO# 460), transfer to
40 ml VOA vial + dilute w/ 0.5 N HCl
Diluent = 0.5 N HCl

Balance 1 used

VOA start: 26.5345 g (empty)

VOA final: 45.8813 g (final, Ra-226 + 0.5 HCl)

 Δ transferred: 39.3468 g

initial ampoule + breaker: 38.0054 g

Balance 1 used

empty ampoule + breaker: 33.0913 g

Ra-226

4.9141 g mass added to VOA

11,900 pCi/g

x 4.9141

58,477.79 pCi

+ 39.35

114861 pCi/g

as of 1/93

 $t_{1/2} = 1600\text{y}$ total ure = $\pm 5.5\%$

final activity conc.

Standard verification Balance 21 GEOMETRY 10

filter + tare: 61.03 g

total wt: 181.33 g

181.33 - 61.03 g =

120.30 g solution

Continued on Page

Read and Understood By

Signed

1/28/99

Date

Signed

2/3/99

Date

000160

Paragon ID 460
Recd 8-25-97

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide	Radium-226		Half-life	1600 years
Nominal activity	60	nano curies		
Nominal volume	5	ml in ampoule/bottle number	2557-4	

Measurement Activity of principal radionuclide

Activity per gram of this solution

11.9	nano curies	of	Radium-226
at 0400 hours PST on			January 1993

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

	curies	Per gram
--	--------	----------

of the daughter nuclide

Total mass of this solution

Approximately 5.0	grams
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Method of measurement

This standard was prepared by gravimetric dilution of NBS Standard Reference Material 4964-B. The specific activity of the dilution was determined by gamma spectrometry by comparing the sum of the activities of the 242, 352 and 609 KeV gamma ray emissions to those of several NBS SRM 4957 Radium-226 sources.

Useful Life

This radionuclide has decayed through

	half lives since it was obtained by EMSL-LV
--	---

We recommend that this solution should not be used after

Indefinite

Purity The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1)	less than equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than \pm [] 0.6 %.
(The 99.7% confidence limits are given by $t(sm)$ where t is obtained from the student t factor for the degree of freedom ($n-1$)).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error ($+ \delta - \delta'$). These have been estimated not to exceed

[] + 3.7 % or [] - 3.7 %

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error [$t(sm)$] at the 99.7% confidence limits and the worst case estimate of the systematic errors ($+ \delta - \delta'$).
The overall uncertainty is therefore calculated on the basis of $+ [t(sm) + \delta]$, $- [t(sm) + \delta]$ and is [] + 5.5 %, [] - 5.5 % of the quoted radioactive concentration.

Decay Schemes This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

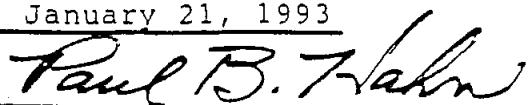
Radium-226 is a member of the Uranium-238 decay chain.
Radium-226 decays 100 percent by alpha emission to Radon-222.

Chemical Composition of Solution	Carrier content per gram of solution: 0.8 micrograms Ba	Other components: 0.5M HCl
		Preservative:

Remarks The measured value and the expected value using the gravimetric factors and the NBS calibration of SRM-4964B differed by 1.6 percent. The average of the two values was used for this standard.

Date Certificate Prepared January 21, 1993

Approval Signature





U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide	Radium-226
Source identification	2557-4, prepared by EMSL
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.0 grams
Source composition	Radium-226 plus 0.8 μg of non-radioactive barium per gram of 0.5 mol $\cdot\text{L}^{-1}$ HCl
Reference time	0700 EST January 1, 1993

	<u>NIST DATA</u>	<u>EMSL DATA</u>
Radioactivity concentration	447.5 $\text{Bq}\cdot\text{g}^{-1}$	440.3 $\text{Bq}\cdot\text{g}^{-1}$
Expanded uncertainty	2.5 percent ^{(1)*}	± 5.5 percent ⁽²⁾
Photon-emitting impurities (Activities at reference time)	None observed ⁽³⁾	None reported
Measuring instrument	NIST pressurized "4 π " γ ionization chamber A calibrated with SRM 4955	Dilution of SRM 4964-B verified using germanium spectrometer system
Half life	1600 ± 7 years ⁽⁴⁾	
Difference from NIST		-1.61 percent ⁽⁵⁾

For the Director,

J.M. Robin Hutchinson, Group Leader
Radioactivity Group
Physics Laboratory

*Notes on next page

(over)

Gaithersburg, MD 20899
September 1994

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NOTES

(1) The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1297* (1993)].

(2) The combined standard uncertainty, $u_c = 1.24$ percent, is the quadratic combination of the standard deviation (or standard deviation of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a)	100 ionization chamber measurements on each of 2 samples	0.31 percent
b)	activity of SRM 4955-55	1.21 percent
c)	gravimetric	0.05 percent
d)	half-life propagation ($\Delta t = 25$ y)	0.005 percent

The expanded uncertainty, $U = 2.5$ percent, is obtained by multiplying u_c by a coverage factor of $k = 2$ and is assumed to provide an uncertainty interval of approximately 95 percent confidence.

(3) Overall uncertainty reported by EMSL.

(4) The limits of detection are:

$$12.6 \gamma s^{-1} g^{-1} \text{ between } 40 \text{ and } 348 \text{ keV,}$$
$$4.75 \gamma s^{-1} g^{-1} \text{ between } 356 \text{ and } 605 \text{ keV, and}$$
$$1.58 \gamma s^{-1} g^{-1} \text{ between } 613 \text{ and } 1900 \text{ keV,}$$

provided that impurity photons are separated in energy by four keV or more from the principle gamma-ray emissions of radium-226 and its daughters.

(5) Evaluated Nuclear Structure Data File (1990).

(6) This result demonstrates the traceability of EMSL to NIST, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NIST interagency agreement of April 1976, as amended.

For further information, please contact Jeffrey T. Cessna at 301-975-5539.

Source identification 2557-4

Daily Checks

Lucas Cell + PMT Daily Performance Check Summary - Detector A, Scalar #1

r:\instalphscnt\dailychk.xls

Historical control limits established 8/28/01.

Obs. #	Date	Count	Gross	OK?	LCL	UCL
		Dur. (m)	Counts			
421	6/1/04	1	9495	OK	9047	9762
422	6/1/04	1	9285	OK	9047	9762
423	6/7/04	1	9467	OK	9047	9762
424	6/7/04	1	9479	OK	9047	9762
425	6/17/04	1	9513	OK	9047	9762
426	6/17/04	1	9454	OK	9047	9762
427	6/21/04	1	9429	OK	9047	9762
428	6/22/04	1	9496	OK	9047	9762
429	6/23/04	1	9571	OK	9047	9762
430	6/24/04	1	9468	OK	9047	9762
431	6/24/04	1	9452	OK	9047	9762

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Lucas Cell + PMT Daily Performance Check Summary - Detector B, Scalar #2

r:\inst\alphscnt\dailychk.xls

Historical control limits established 9/25/01.

Obs. #	Date	Count	Gross	OK?	LCL	UCL
		Dur. (m)	Counts			
402	6/1/04	1	9490	OK	9074	9734
403	6/1/04	1	9449	OK	9074	9734
404	6/7/04	1	9568	OK	9074	9734
405	6/7/04	1	9430	OK	9074	9734
406	6/17/04	1	9449	OK	9074	9734
407	6/17/04	1	9335	OK	9074	9734
408	6/21/04	1	9333	OK	9074	9734
409	6/22/04	1	9475	OK	9074	9734
410	6/23/04	1	9339	OK	9074	9734
411	6/24/04	1	9324	OK	9074	9734
412	6/24/04	1	9612	OK	9074	9734

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Sample ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count				Sample Count			
				Start Date	Time	Counts	Dur. (min.)	Pos. Chk.	Date	Time	Counts (min.)
0405040.9 Duf	4D	22	17	5/21/04	08:12	33	90	90	5/21/04	15:49	67
↓ 10	6C	23	↓	09:53	18	↓	↓	↓	17:31	84	↓
↓ 11	4D	24	↓	↓	23	↓	↓	↓	↓	51	↓
Chub. Source	1A	NA							5/28/04	08:08	9420
	2B									08:09	9397
	↓									08:10	9344
	6C									08:11	9421
	↓										
0404265.8	6C	25	17	5/28/04	08:13						
↓ 8 Duf	4D	26	↓								
0405046.12	1A	6C	25	17	5/28/04	08:26	54	90	90	15:15	67
↓ 13	2B	40	26	↓	↓	27	↓	↓	↓	63	↓
↓ 13 Duf	6C	27	↓	09:58	22	↓	↓	↓	16:55	51	↓
040515.2 MB	4D	28	↓	↓	18	↓	↓	↓	↓	29	↓
Chub. Source	1A	NA							5/29/04	14:39	9446
	2B									14:40	9367
	↓									14:41	9398
	6C									14:42	9368
	↓										
0404265.8	6C	29	17	6/1/04	09:54	4	30	30	6/1/04	09:34	9495
↓ 8 Duf	4D	30	↓	↓	↓	↓	↓	↓	09:35	9490	↓
									09:36	9320	↓
									09:37	9387	↓
									16:07	241	30
									↓	238	↓

Comments:

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Logbook No./Page

Paragon Analytics, Inc.

Sample ID	Scalar / Detector ID	Flask ID	Run #	Background Count				Sample Count				
				Start	Date	Time	Counts	Dur.	Pos.	Start	Date	Time
PEO40525.1-LCS	1A	20	06/16/04	09:54	29	30	61,04	16:07	4784	30	06/16/04	16:07
✓ .MB	6C	17	↓	10:28	3	↓	61,04	16:41	11	4	61,04	16:41
Carus Source	1A	1A	↓	↓	↓	↓	↓	↓	18:07	9285	1	↓
	2B	↓	↓	↓	↓	↓	↓	↓	18:08	9449	1	↓
	6C	↓	↓	↓	↓	↓	↓	↓	18:09	9317	1	↓
	4D	↓	↓	↓	↓	↓	↓	↓	18:10	9508	1	↓
	1A	↓	↓	↓	↓	↓	↓	↓	18:10	08:08	9467	1
	2B	↓	↓	↓	↓	↓	↓	↓	08:09	9568	1	↓
	6C	↓	↓	↓	↓	↓	↓	↓	08:10	9454	1	↓
	4D	↓	↓	↓	↓	↓	↓	↓	08:11	9555	1	↓
046509.5.1	6C	21	17	06/17/04	08:28	3	15	60,00	13:38	4	15	60,00
✓ .IDMP	4D	22	↓	↓	↓	4	↓	↓	14:01	8	1	↓
.2	6C	23	↓	↓	↓	5	↓	↓	14:29	18	1	↓
.3	4D	24	↓	↓	↓	4	↓	↓	14:29	18	1	↓
✓ .4	6C	25	↓	↓	↓	3	↓	↓	14:58	7	1	↓
✓ .5	4D	26	↓	↓	↓	4	↓	↓	14:58	7	1	↓
PEO40602.1-MB	6C	27	↓	↓	↓	6	↓	↓	15:46	9430	1	↓
✓ .LCS	4D	28	↓	↓	↓	0	↓	↓	15:47	9484	1	↓
Carus Source	1A	1A	↓	↓	↓	↓	↓	↓	15:48	9280	1	↓
	2B	↓	↓	↓	↓	↓	↓	↓	15:49	9513	1	↓
	6C	↓	↓	↓	↓	↓	↓	↓	15:50	08:28	9513	1
	4D	↓	↓	↓	↓	↓	↓	↓	15:51	08:28	9513	1
	1A	↓	↓	↓	↓	↓	↓	↓	15:52	08:28	9513	1

Comments:

Collection

J. C. Linton

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Sample ID	Scalar / Detector ID	Flask ID	Run #	Background Count				Sample Count			
				Start	Date	Time	Counts	Dur.	Pos.	Start	Date
CALIB SOURCE	2B	1A								08:29	9449
	6C									08:30	9409
	4D									08:31	9295
0405175.1	6C	29	18	01/17/04	08:34		0	15			
	4D	30					5			14:31	6
1000P	2C	31					3			15:06	7
	6C	19					3			15:07	8
EC010613.1.MB	4D	20					3			15:33	1140
	6C	21					3			17:21	9454
CALIB. SOURCE	1A									17:22	9335
	2B									17:23	9649
	6C									17:24	9439
	4D									09:27	0421
	1A									09:28	9333
	2B									09:29	0460
	6C									09:30	9375
	4D									15:44	11215
041800.S1	1A	1	NA	01/21/04	08:29		18	15			
	2B	2					8				16:13
	1A	2					17				10:07
	2B	1					19				10:46
	1A	3					19				10:51
	2B	4					5				17:15
	1A	4					22				17:19
	1A									18:31	35
										12:41	0

Comments:

Comments:

Comments:

100% F/T
rec'd 3-21-96

radiation standards and check sources
810 Siller Lane Santa Fe, NM 87501
505)473-9538 FAX(505)473-5805

REF.PO# 65-1924

Certificate of Calibration

(Alpha Sources)

The Thorium 230 alpha source was measured in a proportional counter using P-10 as counting gas. The alpha emissions from the surface of the source were measured at its plateau voltage to determine its 2pi cpm rate. Corrections were applied for background, coincidence loss and backscatter factors when applicable. The source is referenced to NIST 90TH4704627A used in establishing traceability.

Active Diameter(or area) 44mm

Mounting Material SS

Total Diameter(or area) 47mm

Thickness 0.79mm

9.150 cpm

\pm 460 cpm 2pi

18.000 dpm

\pm 900 dpm 4pi

0.00812 microcurie

08/20/92 date of measurement

92TH4703015 source serial number

Michael A. Ortiz

Calibration Manager

Charles L. Gonzales

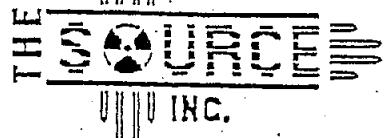
Q.A. Manager

The total uncertainty of the measurement at the 99% confidence interval is 5.0 percent.

AC005

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Daily Performance Checks



Radiation standards and check sources
2810 Siler Lane Santa Fe, NM 87501
(505)473-9538 FAX(505)473-5805

REF.PO# 65-1924

Paragon # 191
recd 3-21-96

Certificate of Calibration (Alpha Sources)

The Thorium 230 alpha source was measured in a proportional counter using P-10 as counting gas. The alpha emissions from the surface of the source were measured at its plateau voltage to determine its 2pi cpm rate. Corrections were applied for background, coincidence loss and backscatter factors when applicable. The source is referenced to NIST 90TH4704627A used in establishing traceability.

Active Diameter(or area) 44mm

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\pm 900 dpm 4pi

0.00812 microcurie

08/20/92 date of measurement

92TH4703015 source serial number

Michael A. Ortiz

Calibration Manager

Charles L. Gonzales

Q.A. Manager

The total uncertainty of the measurement at the 99% confidence interval is 5.0 percent.

AC005

000175

Lucas Cell + PMT Daily Performance Check Summary - Detector A, Scalar #1

r:\inst\alphscnt\dailychk.xls

Historical control limits established 8/28/01.

Obs. #	Date	Count	Gross	OK?	LCL	UCL
		Dur. (m)	Counts			
440	7/8/04	1	9585	OK	9047	9762
441	7/8/04	1	9334	OK	9047	9762
442	7/11/04	1	9541	OK	9047	9762
443	7/13/04	1	9658	OK	9047	9762
444	7/13/04	1	9516	OK	9047	9762
445	7/14/04	1	9488	OK	9047	9762
446	7/16/04	1	9438	OK	9047	9762
447	7/18/04	1	9504	OK	9047	9762
448	7/19/04	1	9486	OK	9047	9762

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Lucas Cell + PMT Daily Performance Check Summary - Detector B, Scalar #2

r:\inst\alphscnt\dailychk.xls

Historical control limits established 9/25/01.

Obs. #	Date	Count	Gross	OK?	LCL	UCL
		Dur. (m)	Counts			
421	7/8/04	1	9533	OK	9074	9734
422	7/8/04	1	9354	OK	9074	9734
423	7/11/04	1	9417	OK	9074	9734
424	7/13/04	1	9212	OK	9074	9734
425	7/13/04	1	9440	OK	9074	9734
426	7/14/04	1	9495	OK	9074	9734
427	7/16/04	1	9293	OK	9074	9734
428	7/18/04	1	9437	OK	9074	9734
429	7/19/04	1	9472	OK	9074	9734